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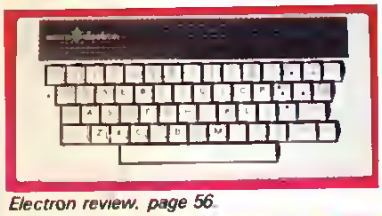
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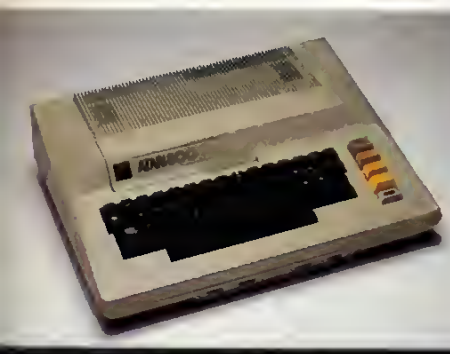
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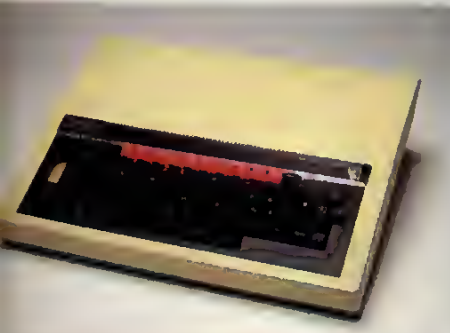
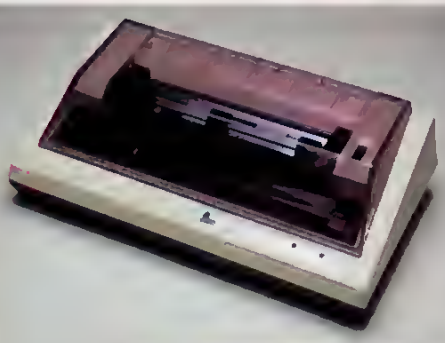




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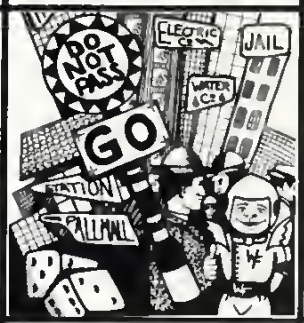
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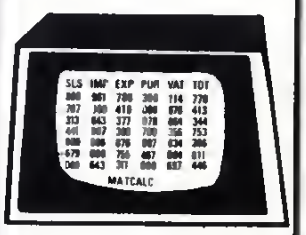
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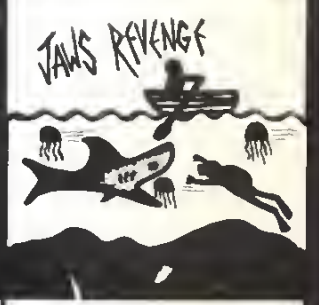
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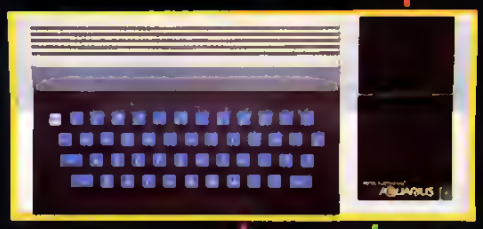
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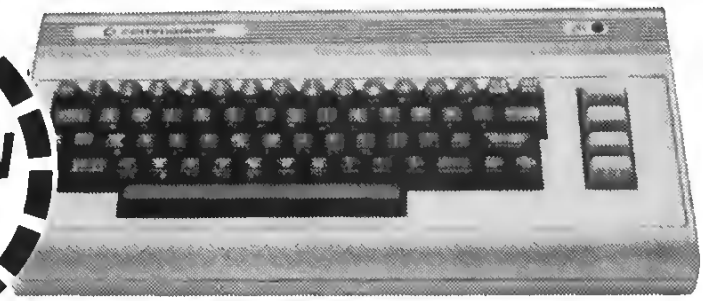
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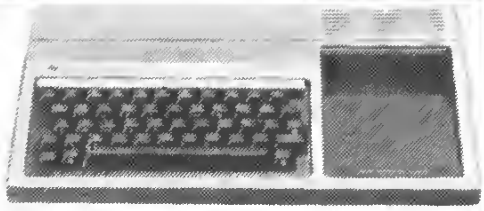
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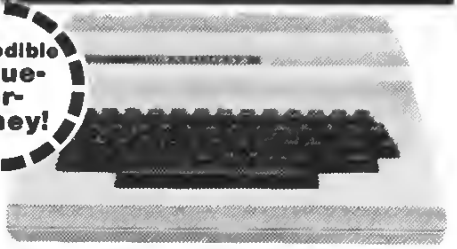


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Not all stores carry every advertised item, please phone before making a journey — Prices correct at time of going to press E & O E

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MAJOR PRICE BREAKTHROUGH!

MICROCARE KEEPS YOUR COMPUTER HUMMING!

Spectrums and Dragons only £19.90 (inc. P + P)

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We'll return it promptly, and we'll quality check your unit before it leaves our service centre.

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These are the real thing ZX81 memory extensions made for the USA and specifically screened to stop radio interference

- ★ no soldering
- ★ easy to fit
- ★ simply plug in
- ★ no loss of memory through wobble or white out

Fully Guaranteed for 12 months

ME1-16USA £15.99 plus 60p P + P



FANTASTIC ZX81 & SPECTRUM SS1 SPEECH SYNTHESISER SIZE 3½" x 5¾" x 1"

- ★ Making amazing speech effects with your ZX Spectrum
- ★ Specially designed for use with your Spectrum. Just plugs in, no dismantling or soldering
- ★ No power pack, leads, batteries or other extras
- ★ Ample volume from built in loudspeaker, Manual Volume Control on panel. Can be plugged in to existing hi-fi system
- ★ Uses no memory addresses.
- ★ Free Dictionary of Sounds.

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Vu load takes the frustration out of loading your ZX81 or Spectrum programmes

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- ★ monitors tape output level
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- ★ detects blank tape without disconnecting cassette wires
- ★ ready to use – no wiring

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NEW

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save it – first time on American microtape

- ★ Specially designed for use with micro computers
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- ★ Uniform coating
- ★ High saturation level
- ★ So good, we can guarantee them for 12 months

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- ★ **no soldering**
- ★ **easy to fit**
- ★ **simple to plug in**
- ★ **fully guaranteed**
- ★ **no loss of memory through wobble or white out.**

NB Before ordering your Spectrum add-on please check which Spectrum you have in your possession At the back of the ZX Spectrum the metallic contact strips can be clearly viewed In the series A the space separating the strips is the same width as the strips In the series B the strips are twice as wide as the space between

SPECTRUM

ME16-48 Series A £34.50 plus 60p P + P
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ZX81

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- ★ **fits most recorders including Radio Shack, Vic-20, Atari**
- ★ **greatly magnifies counter numerals**

LVP £3.99 plus 40p P + P

COMPUTER STANDS

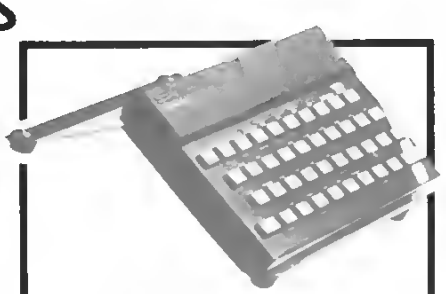
POWER BASE

Raised stand for ZX81 and Spectrum. Fitted LOAD/SAVE switch, and power ON/OFF for screen clearing. Saves wear and tear on connections. Front lip holds computer in place. No soldering, comes complete with all necessary plugs and cables.



Spectrum ref. PBS1 £13.50 plus 95p P + P

ZX81 ref. PBZX81 £13.00 plus 95p P + P



COMPUTILT STAND

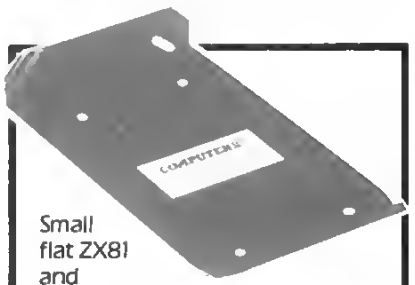
Designed to tilt the computer to a better working position Front lip holds computer in place Also useful as a document stand when entering information

Spectrum or ZX81 ref. CS1 £4.50

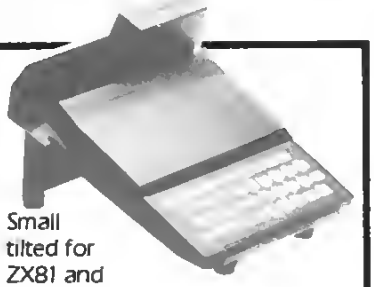
plus 60p P + P

WOBBLE STOPPERS

At last, a fool proof method of avoiding ZX81 whiteouts caused by Ram-Pack wobble Simply turn the plastic thumbscrew until the Ram-Pack is held firmly against the ZX81 No soldering no stick-on pieces, just common sense! Flat or tilted models



Small flat ZX81 and Ram-Pack ref. SW
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Small tilted for ZX81 and Ram-Pack ref. STW
plus 60p P + P **£6.25**



Large flat or tilted for ZX81 and Ram-Pack and Printer ref
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ALL ITEMS NORMALLY DESPATCHED WITHIN 24 HOURS
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TL ☐ ADC12 ☐ ADC15 ☐ ADC20 ☐
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LVP ☐ PBS1 ☐ PBZX81 ☐ CS1 ☐
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*Allow 28 days for delivery

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YC6

COMPUTER ADD-ONS
7-9 Thane Works, Thane Villas London N7

dk'tronics

ZX KEYBOARD FOR USE WITH 81 SPECTRUM

Our new cased keyboard has 52 keys, 12 of which are used for the numeric pad. The numeric pad offers useful features, you can cursor with one hand and it will be a boon for anyone who enters a lot of numeric data. The pad is a repeat of the 1 – 9 keys, it also has a full stop and a shift key. The numeric pad keys are red in colour, the normal keyboard keys are grey, with the case being black, which results in making the keyboard very attractive. The keyboard case dimensions are: 15" x 9" x 2½". The computer (either 80/81 or Spectrum), fits compactly inside.

You will have to remove the computer from it's original case, it is then screwed to the base of the case. The case has all the bosses already fitted and the screw holes are marked. Also fitted inside the case is a mother board (81 model only) which allows 16K, 32K and 64K to be fitted in the case. All connectors are at the rear of the case i.e. Power, Mic, Ear, T.V. and the expansion part. The case is large enough for other add-ons also to be fitted inside. One of these could be the power supply then you could very quickly fit a mains switch or a switch on the 9V line. This means you have a very smart contained unit.This case does not stop you from using any other add-ons that you may have eg Printer etc. We are convinced that this is the best keyboard available at present. It offers more keys and features than any other keyboard in it's price range.

NOTE...

The case can be purchased separately with the keyboard aperture uncut, therefore if you possess one of our early uncased keyboards, or in fact, any other suppliers' keyboards these could be fitted. The keyboard is connected to your computer by a ribbon cable and this has connectors fitted which simply push into the Sinclair connectors. It is a simple two minute task and requires no electronic skills. This keyboard does not need any soldering. Please specify on order whether you require the ZX81 or Spectrum case.

SPECTRUM MODEL

This is supplied with Spectrum legends, and a slightly different base for fitting the Spectrum inside, again, all the connectors are at the rear of the case and there is plenty of room for the power supply (and other add-ons). Should you wish to change, we can supply both the Spectrum legends and details of updating your case which will enable modification from the ZX81 to Spectrum. PLEASE specify on your order whether you require the ZX81 or Spectrum inside.



£45

MEMORY FOR ZX 81

16K Memory £22.95
64K Memory £52.95
16K (Uncased) £19.95
64K (Uncased) £49.95

SPECTRUM MEMORY

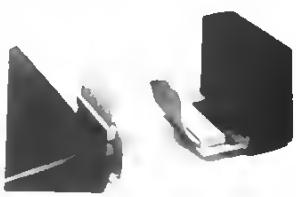
MKI £30
MKII £30





FLEXIBLE RIBBON CONNECTOR

If you have ever had white outs or system crashes this could be the answer. It stops the movement between the computer and the RAM expansion, it is supplied with a ribbon 6 inches long, with a male connector at one end and a female at the other.



ONLY £10

dk'tronics

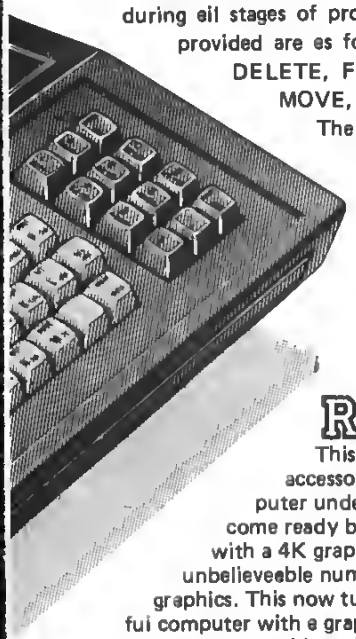
DK Tronics, Unit 2, Shire Hill Ind Est, Saffron Walden
Essex CB11 3AQ. Tel: (0799) 26350 (24 hrs) 5 lines.

ZX 80/81 SPECTRUM HARDWARE

SPECTRUM/81 TOOLKIT BOTH AT ONLY £6.95

This is the toolkit which won acclaim in the feature in the August 1982 issue of Sinclair User. "it is the most impressive programm, fast in execution with clear and full instructions . . . . it stends out from the rest of the field". The ZXED is a powerful editor for use on the expended ZX81. It is intended for use by the serious 8ASIC programmer and offers severel usefui and time seving features most helpful during eil stages of program development. The facilities provided are es follows: ALTER, 8YTES, COPY, DELETE, FIND, HELP, INSERT, KEEP, MOVE, RENUM8ER, AND VERIFY.

The Spectrum Toolkit contains most of tha feetures above plus autoline numberer and append, and will run in the 16K end 48K Spectrum.



4K GRAPHICS ROM £24.95

This modula unlike most other accessories fits neetly inside your computer under the keyboerd. The module come ready built fully tasted and complete with a 4K graphic ROM.This will give you en unbelieveable number of axtre pre-programmed graphics. This now turns the 81 into e very powerfui computer with e graphic set rarely found on larger more expensive mechines. in the ROM ere iower case letters, bombs, bullets, rockets, tenks, a complete set of inveders, graphics and thet only accounts for ebout 50 of them, thara ere still epproximetely 400 left (that mey give you an idee as to the scope of the new ROM). However, tha module does not finish there, it eiso has e spare holder on the board which wiii eccept e further 4K of ROM/RAM. This hoider can be fitted with a 1K/2K/RAM end can be used for usar definable grephics so you cen creete your own custom cherecter sets.

SPECTRA-SOUND

The so celled speaker in your Spectrum is really only a 'buzzer'. With the DK Tronics "SPECTRA SOUND" you cen generete fully emplified sound through the speaker on your T.V. set. SPECTRA-SOUND is a very simple but highly effective edd-on. This means that you no longer have e feint beap but e highly amplifiad sound, which cen be adjusted with tha TV voluma controi.

Tha SPECTRA SOUND fits compactiy end neatly inside tha Spectrum case and is connectad by three smeli crocodiie clips.

NEW AT ONLY £9.95

£19.95 Light Pen

LIGHT PEN

The pen ènables you to produce high resolution drawings on your own T.V. screen. The controlling software supplied with the light pen has 16 pre-defined instructions. These ere chosen from a menu positioned at the bottom of the screen next to the pen.



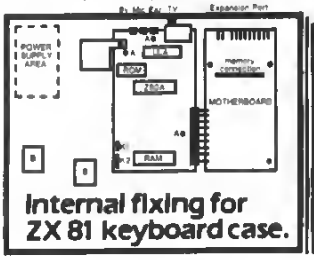
You can utilise tha menu for changing colour (8order, Peper, Ink). Drewing circles, ercs, boxes, iines. You are also eble to fill any object with any colour, and insert text onto the screen at eny chosen piece. Of course you can elso draw freehand. There is a feature to retein the screens end enimete. On the 48K Spectrum you can retain 5 screens.

You cen also use the machine code on it's own in your own programs, for selecting out of e menu etc. The software provided will return with the X,Y, cords for it's position on the screen.

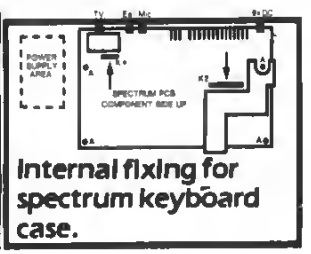
Tha light pen is supplied with a control interface in order to edjust the sensitivity/pen alignment.

This simply plugs into the eer socket on your spectrum.

Should you require further details please send e S.A.E.



Internal fixing for ZX 81 keyboard case.



Internal fixing for spectrum keyboard case.

Please state type of machine, which ROM memory size, quantity, and place whan ordering.

Please send ma . . . . . .@ £ . . . . . .

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Please send ma . . . . . .@ £ . . . . . .

Please add on £1.25 for p/p

I enclose cheque/P.O. payable to DK Tronics total £. . . . . .

or debit by Access/Barclaycard No.

Signature. . . . . .

Name . . . . . .

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Send to DK Tronics, Unit 2, Shire Hill Ind Est, Saffron Walden, Essex CB11 3AQ. Tal: (0799) 26350 (24 hrs) 5 lines.



MAPLIN

HARDWARE

Atari 400 with 16K RAM	(AF36P)	£199.95
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★ Delivery next day by Datapost

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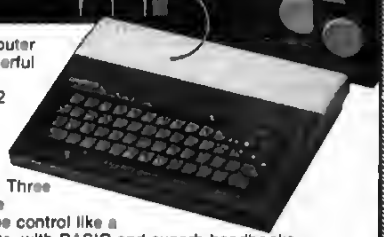
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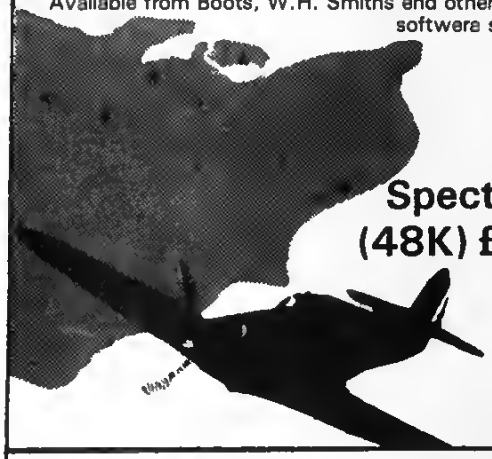
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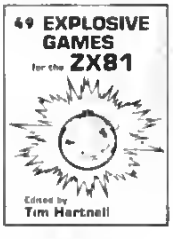
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That feast for computer enthusiasts was typical of the value which Your Computer readers have come to expect. But publishing larger and larger issues means that production and mailing costs have increased and so we have reluctantly decided that the subscription rate must go up. So as from the October issue we will be asking you to pay £10.50 for a year's subscription.

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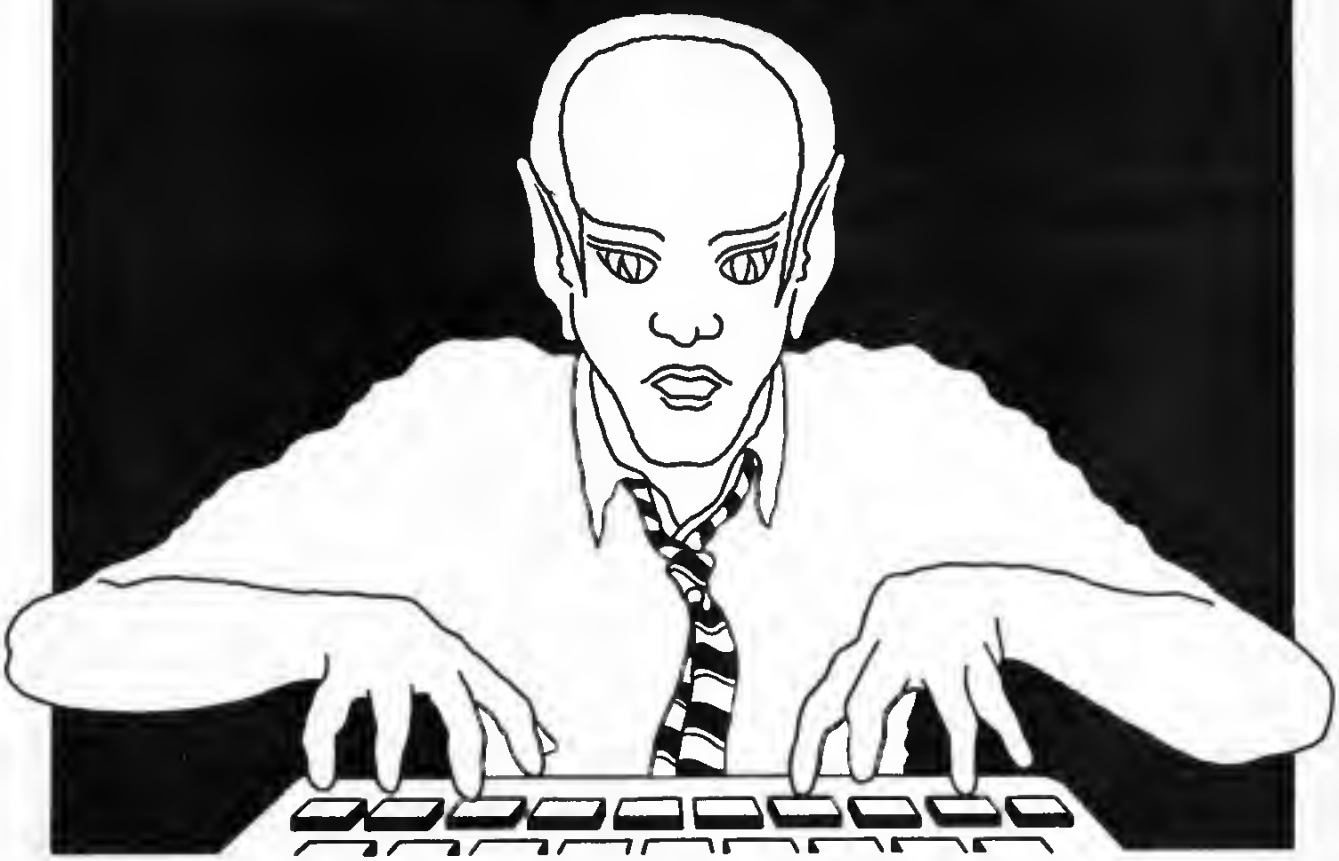
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YOUR LETTERS

SAVE ME FROM ADVENTURE

Deep into my Agatha Christie I hardly heard the surreptitious suggestion "Why don't we get a micro?"

"A micro what?" I asked carelessly, my mind more engaged on the first body in the conservatory than the promises of a microwave or even a microscope.

"You know, a microcomputer", came the knowledgeable reply.

I should of course have decreed there and then that no computer, micro or otherwise, would ever enter our home. Next time I"ll know. The arrival of the black box caused a fuss more generally applicable to the birth of kittens or the death of a great aunt.



We spent long hours playing all kinds of zap and aliens games. Never ending beep-beep-beep, boing, zap and splat, rather like a sort of animated *Beano* with sound. The tapes multiplied, the aliens got nastier and his scores went off the top of the counter. Mine stayed in the hundreds.

Then we bought a maze game and ate apples all day. A definite improvement — my scores rocketed and at last I was the one with eyestrain. We began buying a magazine or two. We read such delights as *Peeking and Poking* and *Debugging Your Program* — akin to delousing?

I had just begun to delight in the intricacies of machine code, getting excited about LDRs and RRCAs and how to collapse my stack, when he triumphantly produced an adventure game.

I tried to explain that I didn't *want* to steal someone else's treasure or chop off a goblin's head — I'm just not violent or materialistic. Golden chalices would simply look out of place on our table.

Every day of the week he rushes home from work to see if he can outwit the witch, swim the river or rescue the helpless princess. My suggestion of saying please to the goblins was met with a roll of the eyes and a "Shshsh — I'm thinking".

Still, at least I can remain undisturbed to discover the identity of the murderer after all. And of course, make the coffee while he is busy rescuing yet another princess in distress.

A M Morton, Kew, Surrey.

ARCADIA RAVE

The reviews would be greatly improved if the reviewers spent more time trying out the programs.

In the July issue, Meirion Jones said that Arcadia was "just a lacklustre version of Galaxians" but that Schizoids — by the same company — was "much better". This is patently untrue! If Mr. Jones had played these two games for some time he would have discovered that Arcadia has 12 screens of totally different aliens, all of which are anything but dull, whereas to score points in Schizoids all you have to do is avoid the rubbish. The software shop that I go to sent a batch of Schizoids back after testing them because they want to be seen selling only the best software.

Also, why review these two and Molar Maul without reviewing Ah Diddums?

Finally, why not bring back the software rating table you used to have at the end of articles. It makes it a lot easier to pick out the good software without having to ask around.

Andrew M Hay, Sidmouth, Devon.

PROGRAM SAVE

In his article entitled Food for the Dragon — *Your Computer*, July — Vincent Cocken used Poke 114,25 to stop the reset button being used to break his progam, stating that the button's subsequent use would result in the computer restarting as if it had just been turned on. This proved only too true and after my loss of the entire program by using Reset in the middle of the program I wrote the following short machine-code routine for the Dragon which will reinstate any program which has been Newed in this way. The program will also work after a normal New or after any other crash providing that the power supply has not been interrupted.

The routine will bring back a lost program on entry of Exec 32750. However, the program will not work if a new Basic line has been entered or a new variable assigned.

```
10 CLEAR 200,32749
20 DATA 158, 25, 189, 131, 243,
   48 2, 159, 27, 159, 29, 159
   31, 57
30 FOR T=1 TO 14
40 READ A: POKE 32749+T,A
50 NEXT T
```

Andrew Williams, Southport, Merseyside.

GENERATING SOUND

I saw the Mozart lives article — *Your Computer*, March 1983. I already had a programmable sound generator, the Zon X-81 by Bi Pak — and wondered if it would work. After a lot of typing I eagerly connected my sound generator and hey presto! It did not work. After all that typing I was not going to give up. I worked out what changes needed to be made and it worked perfectly.

If anybody would like to use their Zoo X then the following changes will have to be made.

In line 3 change the values of R and RO:

```
LET R  = 223
LET RO =  15
```

Change line 4 to:

```
4 LET PL = 32350 : IF PEEK 31415
<>145 THEN LET KY = B/KY
```

Then enter as direct commands:

```
POKE 32430,223
POKE 32470,15
POKE 32479,223
```

As I said earlier it takes a lot of typing but it is well worth it as it shows the capability of the PSG and makes a change from the usual explosions, zaps and so on.

Kevin Sibley, Slough, Berkshire.

INTEGER STORE

In your July issue Nick Goodwin says he has not found much use for multi-dimensioned string arrays. One use on the ZX-81 is to store a list of positive integers in two-byte form, as otherwise the ZX-81 lacks this facility.

Integers up to the limit of 65535 can be placed in a two-dimensional string array of the form A$(N,2) with the lines:

```
LET A$(N,1) = CHR$ INT
  (intager/256)
LET A$(N,2) = CHR$(intagar-CODE
  A$(N,1)×256)
```

This makes it possible, for instance, to store all prime numbers up to 65535 in less than 16K. An undimensioned string cannot do this because, as Mr Goodwin points out, in practice it cannot be espanded much beyond 7K. Such a list is sufficient for testing for primes up to the ZX-81's limit of accuracy.

Barrington Bayley, Telford, Shropshire.

LITTLE BUGS

A little bug crept into the Ace sounds article in your July issue. It occurs in the word defined as Note. The mnemonics

```
IN A,(0) and OUT A,(0)
```

both need a number after them to function correctly. In this case the numbers are both zero, so the word Note should read:

```
CREATE NOTE 205 e, PAUSE , 219 e,
  0 e, 205 e, PAUSE , 211 e, 0 e,
  29 c, 32 c, 243 c, 201 e,
```

Another problem occurred in Mark Carne's Dangerman in the Software File of the same issue. Although the actual program was correct there was no way of telling what character the question mark in line 1 was. It should have been CHR$ 78 To enter this

NOBBLING SPECTRUM SOFTWARE

Quote from your April news item, Double Dragon. "Commodore . . . would only say that price was 'all to do with what the market will bear — not to do with what it costs to make'." Quote from your February Response Frame, Time Bomb: "In the first place copying commercial software is robbing the programmer of his/her royalties . . . I can have little sympathy for you if . . ."

Atari software usually sells at between £10 and £30. Also, it is unusual for a Spectrum program to set one back by more than £10. These prices refer to cassette tapes. Of course, games software for the Atari machines is almost certain to be more satisfying but this is a function of the machine, not of the software houses.

In fact, upon careful examination of software pricing one is quickly struck by the fact that the price of commercial software is positively correlated with the price of the host machine. Slight non-linearities in the correlation can be accounted for by introducing the gullibility factor associated with buyers of particular machines.

I nobble software. I do so to acquire a program for my personal use. I also buy. I won a Spectrum and, as a student, I am temporarily affluent. This mixture of buying and procuring makes the average price more realistic. There is no way a program can be made impregnable to someone who is *au fait* with the host machine, so long as the expenditure of effort continues to be rewarding.

If the programmer finds himself suffering from reduced income and if lots of these creative gents so suffer, then their collective misery may yet bring upon them the realisation that it is they and we who count in this sordid business, and they may send their middlemen to join the Golgafrincham Fleet.

Probably not, though. The consumer electronics industry, which now has a good grip on micros, will not allow it. Not that I mind. I keep my overheads low. I manage. But now and then I feel really sorry for others, the consumer classes, those poor unimaginatives, terrified by imaginary time-bombs.

Tim Magee, Bradford, West Yorkshire.

just enter the following Poke, not forgetting to put a space after the graphic T:

POKE 16517,78

Incidentally, I was very impressed by "Ace sounds".

Timothy Skinner,
Hoveton,
Norfolk.

SWAP FAULT

Although I think I checked my Swap program in the July issue, a fault sneaked in.

I discovered it when I got a letter from R J Fox, Surrey, another *Your Computer* reader, who asked me how to change the program to divide a 32K RAM into two 16K parts.

First the error in the original program. Even if it might seem to work, it only swops two 6K parts instead of two 8K parts. To correct this, change the contents of 16537 to 1F H.

To split a 32K RAM into two 16K parts, start by Poking 16389,127 and New. After this, change 16531 to 80 H and 16537 to 3F H. All USR-routines start at the same adresses

Peter Havlykke.

HARDWARE

In the article Submarine Mission in the August issue of *Your Computer* details of hardware were omitted. The two-computer version — to be covered in *Your Computer* October was written around the PSG1O — sound/1O — board used for the Mozart programme in your March edition. One board is needed for each computer, though only a single connecting cable is necessary. Like the cassette, both are available from Protek Computing, Clydesdale Bank Bldng, S. Queensferry, Scotland.

Prices are as follows: PSG1O board, each £19.25 inc p/p; cable £4.75 inc p/p.

Rod Hopkins,
Dunfermline,
Fife.

The correction for the 48K version of the Spectrum 3D rotator in *Your Computer*, August Letters, itself stands in need of correction. F6 is of course a printing error and should read F7.

Lines 40 to 60 in program 1 of the Vic Saucer Attack in the August issue have been corrupted. Fortunately this program just prints the title screen and can be left out. More importantly some of the data items in program 2 are illegible. The last three numbers in line 200 are 68, 254, 254; the last five in line 210 are 124, 254, 254, 16, 56; and the last three in line 220 are 124, 254, 254.

If you are unable to key in the program but would like a tape of it, send £3.50 to: Damien McComb, 23 Woodland Drive, Quarry Vale, Dungannon, Northern Ireland.

In August's BBC Squeeze program line 4090 should contain the number 155 instead of 150.

EDITORIAL

THE CEASEFIRE HAS BROKEN. After 16 months of silence the big guns of British home computing, Sinclair Research and Acorn, opened up on the same day. Both the Microdrive and the Electron have been on the verge of being launched for so long that neither holds any real surprises — beyond the fact that they now really do exist.

What is surprising though is that the Microdrive is likely to have a greater bearing on computing in the immediate future than the Acorn computer. It is probably the first time an add-on has upstaged a new micro from any company let alone one from a manufacturer as important as Acorn. With the Microdrive Sinclair has proved that a product need not be mechanically sophisticated to be technologically significant.

The months of waiting may indicate that the Microdrive has been costly to perfect even though the components it contains are inexpensive. Because it costs little to build, in a year's time you will probably be able to buy the Microdrive and Interface 1 together for £50 and blank cartridges for £2. After all the minimum price of the 16K Spectrum has dropped from £125 to £90 in just four months.

But even at its present price the Microdrive will affect demand for storage devices above and below it in cost. It fills the yawning gap between the sluggish cassette and the expensive floppy disc drive.

Other companies have also been aiming to make that bridge — Coleco, for example, and Texas Instruments — whose £109 Wafertape is due shortly. Providing Sinclair's product proves sufficiently reliable the price of floppy disc drives may be forced down to compete for sales to those who want fast mass storage for their home micro. At the moment the cheapest disc drive costs three times as much as the Microdrive.

In the 1960s the Philips compact cassette knocked out the reel-to-reel as the main erasable recording medium. Many are now asking whether the Microdrive will in turn deal a similar blow to the cassette.

Sinclair's drive is part of a two-pronged attack on cassettes. His Interface 2, due to be launched later this autumn has a port for cartridges as well as a joystick facility. With plug-in cartridges available for the Spectrum — the machine that sells more cassettes than any other — the effect on the way software is sold in this country could be dramatic.

At the moment cartridges make up only a tiny percentage of all program sales in the UK but in the States, where all the big-selling micros have ROM cartridge ports, there is a fifty-fifty split. For machine owners plug-in modules rule out loading problems; for software manufacturers they reduce the risk of piracy and can justify higher selling prices.

The Microdrive itself could also have something to say on the matter of piracy — but only if Sinclair sells tapes to the software houses at a low enough level to make the difference between a blank and a commerical program as small as possible.

Using the Microdrive the sort of software that runs on the Spectrum will become more ambitious: mass storage favours games of strategy, such as board-games and complex adventures, as well as the more serious spreadsheet programs that could load VisiCalc-type files from the stringy-floppy.

It is clear that Sinclair has transformed the Spectrum without making any changes to the machine itself. But if only Sinclair would produce a real keyboard, a Spectrum-like machine incorporating two Microdrives could out-perform micros which cost more than £1,000.

How to write for *Your Computer*

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

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Today's American Timex-Sinclair 2000 could be tomorrow's British Spectrum



NOW THAT THE NEW range of Timex Sinclairs has gone on sale in America the implications are clear for Britain. Sinclair's launch of the Interface II in September which allows cartridge software and joysticks to be plugged into the Spectrum is only a temporary measure. To keep the Spectrum competitive as Texas, Atari and almost everyone else drops their prices to £100 Sinclair will have to build in even more features. Although he plans to move into the 16-bit arena Sinclair is not planning to move out of the games machine bargain basement just yet. A Spectrum with built-in cartridge and joystick ports together with three channel sound and a better keyboard around fit the bill. This is almost exactly what the Timex Sinclair 2000 is. The Spectrum lookalike Timex 1500 is merely a ZX-81 with a built in 16K RAMpack.

In the 1980's a microbus was a red VW van full of hippies. Now a Swansae Sord dealar called Coteglade has appropriated the word to mean a double-decker loadad with microcomputers. "There is no way that a person in Bangor or Aberystwyth is going to travel to Swansee simply to saa us" says Coteglada's Andy Shercliff "so we must go to them".



Dragon — speak to me

NOW YOUR DRAGON will be able to articulate — a synthesiser enabling speech to occur simultaneously with graphics is available from JCB Microsystems

Depending on length of individual words, around 40 words can all be spoken from one command. Five new Basic commands are introduced when the module is plugged in. The Say command controls around 200 predefined words, but you can create your own vocabulary from a set of 64 allophones, or speech sound components.

The £37.95 speech synthesis module is based on the General Instrument SP0256 Speech Processor. Apart from the Texas Instruments synthesiser, which is also used in the BBC, there is only one other chip, the Votrax, in current use for this end of the market.

CRL names the fifth man



THE SMILE that says I've finished. Following three months of after-school programming, 15-year-old Richard Taylor has put the final touches to Fifth, an extension to Spectrum Basic for the machine-code-shy games programmer.

Taylor is also author of the highly successful Computer Rentals High Resolution program for the ZX-81, the software equivalent of a course of monkey glands for Sinclair's aging machine.

CRL boss Clemeot Chambers is clearly deeply impressed by Taylor's software writing: "After the hi-res program I thought 'Who is this masked man'." At £9.95 Fifth offers 25 commands and 13 extra functions for fast and smooth animation and will also help you create more impressive sound effects.

It is interrupt-driven and so is unaffected by the speed of Basic. Its main advantage for the layman over machine code is that a Fifth routine can be nested in a Basic program and because of its Basic-like format reveals at a glance just how it works and what it is there for.

Sinclair prize for breakfast

SNAP, CRACKLE, POP, zap, zap, zap; Tony the Tiger says Sinclair is Grrreat! Instead of the traditional plastic cartoon characters which drop out of the box into your bowl of cornflakes, Kellogs and Asda stores have come up with a new way to sell more cereals. From 12 September to 8 October anyone buying a packet of Frosties and a packet of Rice Krispies from an Asda store will be able to enter a wordsquare competition to win £250 of Sinclair goodies. Each of the 93 stores will have a prize to give away consisting of a 48K Spectrum, ZX Printer and ten Sinclair cassettes ranging from Vu 3D to Horace goes skiing.

Prices — Texas and Atari enter the £100 bargain basement



TEXAS INSTRUMENTS has set off another avalanche in computer prices by dropping the 16-bit TI-99/4A from £150 to £99. Better design has made the cuts possible. Atari is reacting by dropping the price of the 400 to around £100 and the 800 to £200 in order to make way for the new 600XL which arrives this month for £159 and the 800XL which will cost £249.

Rumbelows has taken £10 off the 16K Spectrum, to £89.95 and Sinclair is selling a ZX-81 starter pack which consists of ZX-81, RAMpack and a free software cassette for £45. Two years ago it would have cost you £125. With ZX-81s wholesaling at less than £20 further cuts are likely. The Colour Genie previously £199 for 16K is now on sale at £168 for 32K plus £40 worth of free software.

The Aquarius is not being officially discounted by Mattel, although Silica Shop is offering the 4K machine with 16K of RAM for £99. The RAMpack would ordinarily cost £29.95. Sord has already sliced the M-5's price by £40 to £149.95. Existing M-5 users will be able to obtain the Basic-G graphics cartridge, ordinarily worth £35 for free.

Dragon Data believes that "There are two market leaders as far as we're concerned — Sinclair and Dragon," and to this end a 64K Dragon will soon be introduced for less than £200. A Dragon 128 is also planned. Officially Commodore who helped to start the price collapse by reducing the CBM 64 to £239 will only say "Everyone else is fighting us," but in America the 64 is set to drop to $99 eventually. In Britain the price could be £150 this year and £99 next with the Vic-20 selling for unbelievably low prices.

Your Computer breaks record

YOUR COMPUTER is now much the biggest-selling computer magazine in Britain, and that is official. The latest figures from the Audit Bureau of Circulations which keeps watch on magazine and newspaper sales shows that *Your Computer* sold an average of 120,488 copies each month for the first half of this year. No other computer magazine has yet broken the magic 100,000 barrier. When *Your Computer* started up in June 1981 it was Britain's only home computer magazine. It started as a bimonthly with a 40,000 print run but was such a success that it went monthly in October of the same year.



Your Computer artist's impressions of the new range of Sinclair micros. The decision to move up from 8-bits to 16-bits has delayed their introduction but both the desk-top and the portable should come next year.

ZX-84 sweet 16-bitter

WHATEVER SINCLAIR may do to freshen up the appeal of his 8-bit Z-80 based ZX-81s and Spectrums he knows that the future lies with 16-bit processors with greater speed that can address more memory.

The core of his plans for 1984 is a £300 machine designed around a Motorola 68000 16-bit processor, which will compete with business machiens like the IBM PC which can cost ten times as much. Sinclair's machine will incorporate Microdrives which will make it slower than its disc-based rivals but will make it easier to make it portable.

Sinclair would like to build the flat screen into the project — now codenamed ZX-84 — but delays may make that impossible. His first flat screen TV will now probably be launched in October and so it may not be possible to produce the larger flat screens for the ZX-84 till the middle of next year.

Sinclair watchers speculate that the ZX-84 will also contain a Z-80 chip, partly to encourage current ZX fans to move up.



Olympus is offering a pocket-sized microcassette recorder designed specifically for loading home computers. In addition to storing programs on CT15 tapes the Pearlcorder C100 can be used as a conventional dictation recorder. The only catch is the price, around £70 when it is launched next month.

Apple falls on the MPF II

WHEN THE MICROPROFESSOR MPF II appeared, with the performance of an Apple for a fraction of the price it looked too good to be true. Now Apple has obtained a high court order restraining Sirtel from selling the Microprofessor in Britain. Apple's Mike Spring claims that the MPF II which is built by Multitech in Taiwan contains a copy of the Apple ROM.

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	Bonka	Morrison	Dragon
	Flight Simulator	Psion	ZX-81
	3D Grand Prix	D K Tronics	ZX-81
	Hobbit	Melbourne House	Spectrum
	Jet Pac	Ultimate	Spectrum
	Jumping Jack	Imagine	Spectrum
	Krell	Rabbit	Vic 20
	Krazy Kong	Software City	Vic-20
	Manic Miner	Bug Byte	Spectrum
	Pimania	Automata	ZX-81
	Protector	Quicksilva	BBC
	Q S Synthesiser	Quicksilva	BBC
	Shamus 2	Synaps	Atari
	Starship Command	Acornsoft	BBC
	Transylvanian Tower	Shepherd	Spectrum
	Traxx	Llamasoft	Vic-20
	Winged Avenger	Workforce	Spectrum

My Talking Computer will teach me to tell time and learn tables



YOU ARE NEVER too young for computers says Burke C Pullman of Microspeech. The first product from Microspeech designed to demonstrate this is a talking computer for 3 year-olds and up. For around £60 My Talking Computer comes complete with a suite of programs ranging from a talking clock which Microspeech claims can teach a child to tell the time in less than a day, to tables programs, calculations and games.

Burke C Pullman says that they adopted a non-standard keyboard because "the Qwerty keyboard is intimidating." Each program has a separate overlay for the spillproof keyboard and the overlays are bound into a book. When the child pushes the square marked On an American woman's voice asks him or her to press Go and then asks questions or plays games which require the child to respond by pushing the correct areas of the keyboard. The most spectacular program is the talking clock which has clock hands instead of the keyboard which the other programs use. The voice issues commands like "Set the hand to two thirty" and soundly ticks-off anyone who gets it wrong before eventually giving instructions to get it right. The Talking Computer has been used with some success in a remedial unit at Fountaindale School.

The machine is battery powered and sturdily built to resist the ravages of young children. Inside it has an 8-bit processor not entirely unlike a 6502, 28K of RAM and a massive 128K of ROM containing 21 programs. The computer will accept further 128K and 256K ROMs which will deal with music, learning foreign languages, and more games. My Talking Computer was designed in Britain by Microspeech and Electroplay and is manufactured in Hong Kong. It will be available in High Street stores from October.

Snow white software from magnificent 7

SEVEN LEADING U.K. software houses have formed the nucleus of an organisation which says it is committed to maintaining promised mail-order delivery times, replacing defective stock and dealing promptly with customer and dealer complaints.

Gosh, as Batman would say — and indeed GOSH is the acronym formed from the new organisation's title, the Guild of Software Houses. The seven sisters of the British software world who founded GOSH are Bug-Byte, New Generation, Virgin, Salamander, Quicksilva, Silvasoft and Softek. So if these companies are failing to provide you with proper service you now have carte blanche to get on the phone to GOSH secretary Mike Johnston, 01-801 9172.

"We needed an organisation with teeth which means putting in a lot of money to run an office" commented Guild Chairman Nick Alexander. So members pay a hefty £500 on election to the Guild. If they blot their escutcheon they will be subject to the Guild Disciplinary Procedure involving fines, explusion and general casting into the outer darkness.

The Guild is really the brainchild of the Computer Traders Association, itself formed in September last year by companies like Atari, Tandy, Boots, John Menzies, Virgin and Silvasoft. "There are two aspects to software trading — political and legal" said Nigel Buckhurst of the CTA. "While we're very good on export advice and dealing with government departments, we felt it was wrong for CTA to get too involved in legal problems, which are also very expensive."

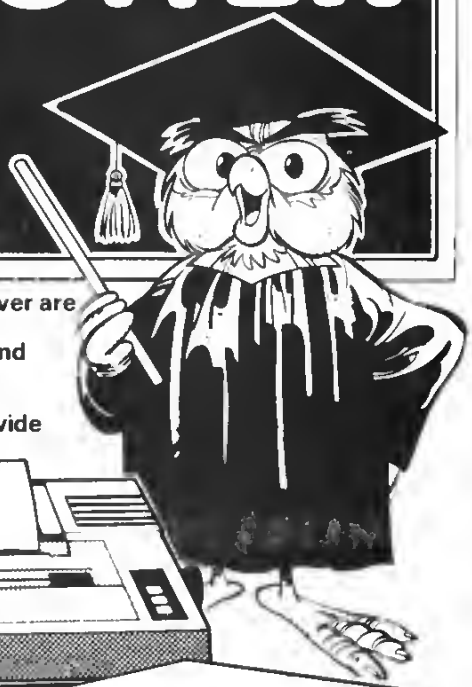
Hence the formation of the Guild. As time goes on, CTA plans to form other specialist sub-groups and is working on one dealing with business computers together with the Office Machine Equipment Federation.

More importantly CTA has plans to stop the selling of software in the U.K. altogether. This is a legal nicety — software will be licensed rather than sold, so it will never be the property of the end user. This would make life tough for tape libraries and software poachers. This could be almost as revolutionary as the clause in GOSH's customer guarantee that says members undertake to avoid advertising products as available before this is in fact the case.

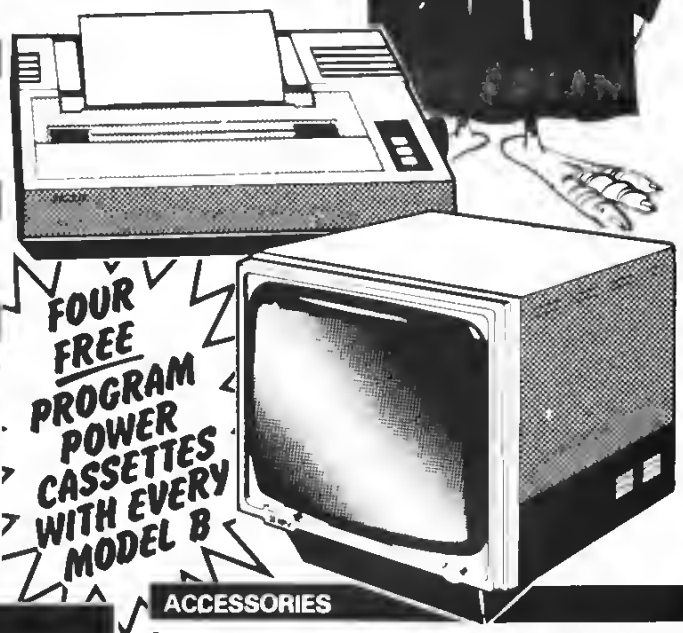
Sweet Talker is a new plug-in speech module for the Spectrum from Cheetah Marketing. It is an allophone speech device with a built-in speaker. Cheetah promises "no more lonely nights — a companion for just £34.95" presumably referring to the time it will take you to program in speech one sound at a time. Also illustrated is Cheetah's 32K RAMpack for the 16K Spectrum, which costs £39.95. Cheetah is on 01-240 7939.



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MICRO POWER - PUT TO THE TEST WE'LL PASS WITH HONOURS!

I could do that...

Computers use quite a nice trick when they subtract one number from another: they simply switch all the bits in the number to be subtracted — 0 to 1, and 1 to 0, then add 1 — called the "two's complement" of the number. Then all that need be done is to add the resultant numbers. For example: in a 4-bit computer, taking 5 from 11 gives, in binary:

```
                1011
              - 0101
First — Invert 5  1010
Second — Add 1    1011
Now add           1011
                +1011
                -----
Gives            10110
```

The most significant bit will not fit in 4 bits — and the computer simply ignores it . . . so it is left with 0110 — 6 — the correct answer! Last month's puzzle dealt with addition — so those of you that did the puzzle will already have done half of this month's. We are looking for the best program to take two 16-bit numbers, in binary, and subtract the second from the first, giving the result in binary too. Next month: Multiplication.

July's competition to write a program which displayed the spread of random numbers proved easy enough for most entrants. The £15 prize goes to S Middleton, 57 Downs Valley Road, Woodingdean, Brighton, for the following program to run on a Dragon 32:

```
10 R=100 DIM F(R)
20 PMODE 4,1.PCLS 0:SCREEN
   1,1
30 FOR I=1 to 150*R
40 N=RND(R)
50 F(N)=F(N) + 1
60 PSET (28 + N*200/R,
   192 - F(N))
70 NEXT I
80 GOTO 80
```

BEGINNERS *First bytes*

Starting out in home computing? First Bytes is for you. Just write to *Your Computer* with any hardware or software problems, no matter how small or simple.

Machine code

"Not only do I not understand machine code but I find the business of typing in other people's machine code programs confusing. Could you explain what, for instance, a hex loader is and what it does?"

UNLESS YOU HAVE an assembler there are two problems with writing machine code on a home micro; that is, where to enter it and how to enter it.

These problems are highlighted on the ZX-81. So slow is the ZX-81's Basic that anyone wanting to write a fast-moving game is greatly encouraged to learn machine code, and perhaps more people have learnt Z80 code on this micro than on any other. Yet, at the same time, it is a particularly awkward micro on which to write machine code.

For a start where can you store the code? One possibility is to lower the top of the Basic program area, RAMtop, and house the code above it. But how can you save it there? Unlike other micros the ZX-81 has no facility for Saving a specified block of memory: you can only Save a Basic program.

The solution adopted by most programmers is to store the code within a Basic program in a Rem statement. It can be safely Poked into the line after the Rem since the Basic interpreter ignores any character after the Rem.

First you need to ensure that there are enough characters on the line to accomodate your machine code routine and also you need to find out where in memory the Rem begins — the start address of your machine code. If the Rem statement on the ZX-81 is the first program line the start address will be 16514.

This rather cumbersome procedure is unnecessary on most other micros. Commands like the Spectrum's Save " " code and the Dragon's CSaveM allow you to Save a stretch section of code anywhere in memory, whether within a Basic program or not.

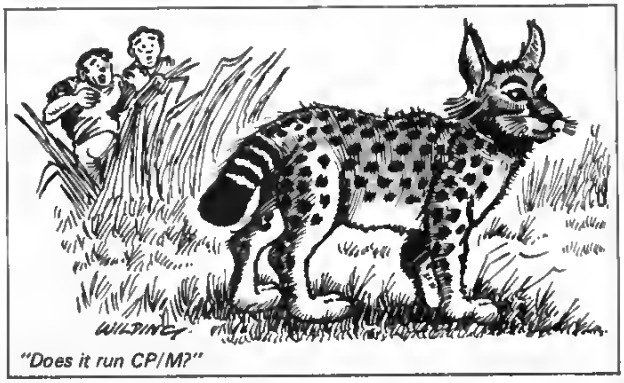
The other problem that often mystifies beginners is the business of entering code. It is probably easiest to insert the machine code instructions in Data statements, read them into a variable and then Poke them into the required section of memory.

The alternative is to input them directly from the keyboard and for this you will need a hexadecimal or decimal loader. A good loader should allow you to input numbers either one at a time or in string and then print out the number and the address to which it has been Poked.

In addition a hexadecimal loader will need to convert the hexadecimal input to decimal. This is because although most machine code programmers prefer to work in hexadecimal most home computers require a number to be in decimal before it can be Poked into memory.

You do not need to understand machine code to be able to use it in your own programs. Many short but effective routines have been published. Typically they are for scrolling the display or inverting the display. If you understand how and where to insert them you can easily pep up your Basic programs.





"Does it run CP/M?"

What does CP/M do?

"Can you define CP/M and explain its advantages?"

CP/M IS A SPECIAL type of program known as an operating system. It usually comes as a standard supplied software package with larger computer systems. Generally it runs on Z80 or 8080-based micros, though there are versions available to run on other processors. It also requires a certain amount of memory, usually 64K and at least one disc drive.

The Camputers Lynx will probably be the first cheap home computer capable of running CP/M, which will greatly increase its importance. But for it to be capable of doing so a user must add memory, in this case 128K of RAM is needed, and a disc-drive.

Nowadays CP/M is firmly established as the standard micro operating system, especially among business or serious users. Originally it was developed as a tool for hobbyists by Gary Kildall, a young

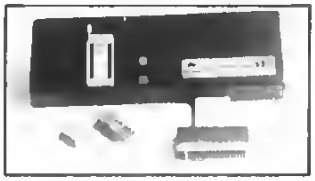
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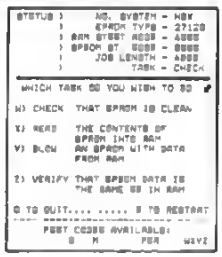
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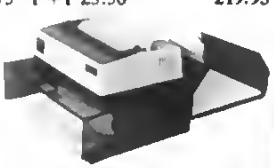
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(continued from page 45)

American computer fanatic who is now a multi-millionaire at the helm of Digital Research, one of the largest micro-software houses in the world.

What makes CP/M so wonderful is that it makes every computer look the same as far as software is concerned. In principle you should be able to load a disc from any CP/M computer into another and the software contained on the disc should load. In practice this does not often happen because different machines use different disc formats and have differing disc hardware.

Discs recorded in the IBM format tend to be the most common and they can usually be swapped between different CP/M machines. The larger machines usually have Basic on disc rather than in RAM, and this means that applications software, that is the programs that run on the machines, only have to be written for one CP/M machine.

It is a trivial matter to transport them to other CP/M machines provided they contain no instructions that make special use of a machines features.

Because CP/M is available on such a wide range of machines, there is a very wide choice of available software. Any manufacturer designing a new business micro will choose to run CP/M as this wide range of software makes his micro look all the more attractive to the buyer. A software manufacturer, on the other hand, will develop software for CP/M because so many people already have it.

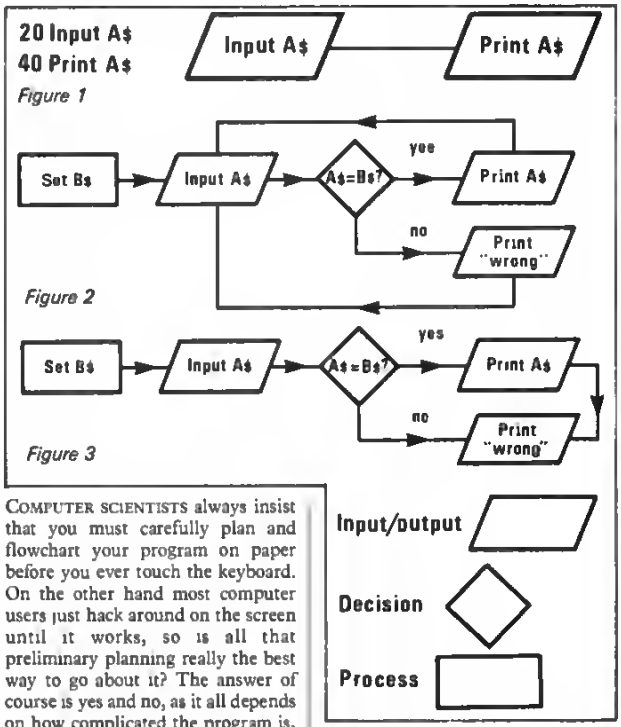
Digital Research has developed a similar product to CP/M which performs the same standardising task, but for graphics. It allows a programmer to develop graphic images on one machine, and will allow the same image to appear on another machine when fed with the same data.

It is unlikely that CP/M will appear on the Spectrum, although not impossible. The reason for this is that Sinclair Research has opted for a non-standard mass media, the Microdrive, and supports it with a number of built-in commands — the ones that appear on the keyboard but cannot yet be used.

Also as the Spectrum has only 48K, loading in CP/M and a relevant version of Basic would not leave much room for applications software.

BEGINNERS *first bytes*

Program flowcharts



COMPUTER SCIENTISTS always insist that you must carefully plan and flowchart your program on paper before you ever touch the keyboard. On the other hand most computer users just hack around on the screen until it works, so is all that preliminary planning really the best way to go about it? The answer of course is yes and no, as it all depends on how complicated the program is, and how experienced you are.

Without a doubt flowcharts are an excellent way of finding bugs in your programs but to make a start you need to understand the language. There are many symbols used in flowcharting but as far as most programs are concerned there are only three different situations and symbols to worry about.

Input/output describes entering responses from the keyboard or joysticks and sending output to the screen, sound channel or printer.

Process describes any part of the program which manipulates the information.

Decision points are usually the most important parts of the program as it is the arrangement of these which make the computer appear intelligent.

Figure 1 is a very simple flowchart of a routine to print a character on the screen.

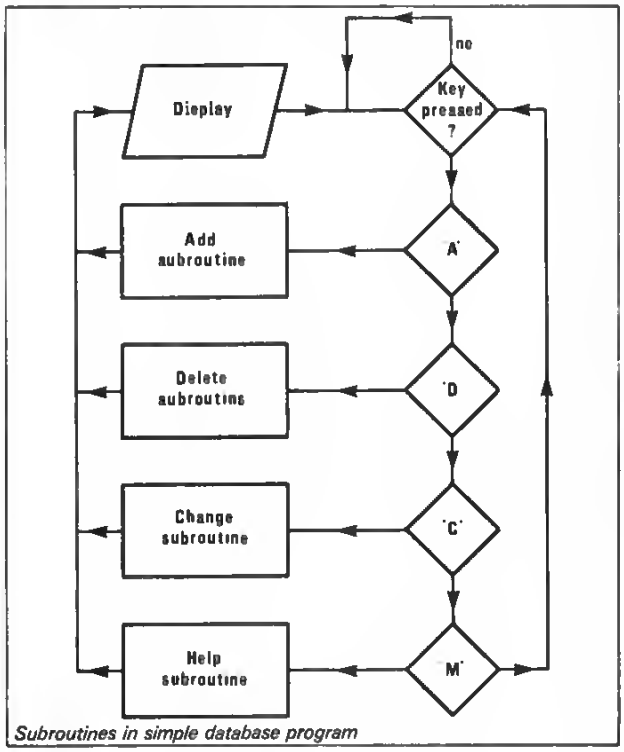
Now add a process, a decision point, and an alternative program path.

```
10 LET B$="TEST"
30 IF A$<>B$ THEN 100
100 PRINT"WRONG"
See Figure 2
```

Of course that program does not do what you really wanted as even if you are right you are told you are wrong! What we need to add is a longstop which catches you when you are right, and why not automatically return for another input? There is no point going back to the start as B$ is still set.

```
50 GOTO 20
110 GOTO 20
See Figure 3.
```

Keith and Steven Brain



Subroutines in simple database program

Using subroutines

MOST VERSIONS OF Basic allow you to use subroutines, but when should you bother to use this programming method? The important thing about calling a subroutine with Gosub is that the program remembers where it was and Returns to that particular point. The parts of a program to put in a subroutine are really any groups of lines which are used several times.

There is not much point in putting a single instruction like

```
PRINT A$
```

as a subroutine, as you still have to put Gosub — line number — wherever you want to call it in the program. The more complicated your program and the more complex the contents of your subroutine, the more useful it is likely to be.

Arranging your program as a series of subroutines can make it easier to plan, and may also make it run faster. Frequently used subroutines should be put near the start of the program, as each time a Goto or Gosub is met the system searches for that line number from the start of the program.

Parts like instructions which are not needed frequently are often put at the end of a program and are only called at the start of a program, or if you need help. For example, a simple database program might consist of a help subroutine, three 'action' subroutines, and a keycheck routine which decides where the program should branch. See drawing above.

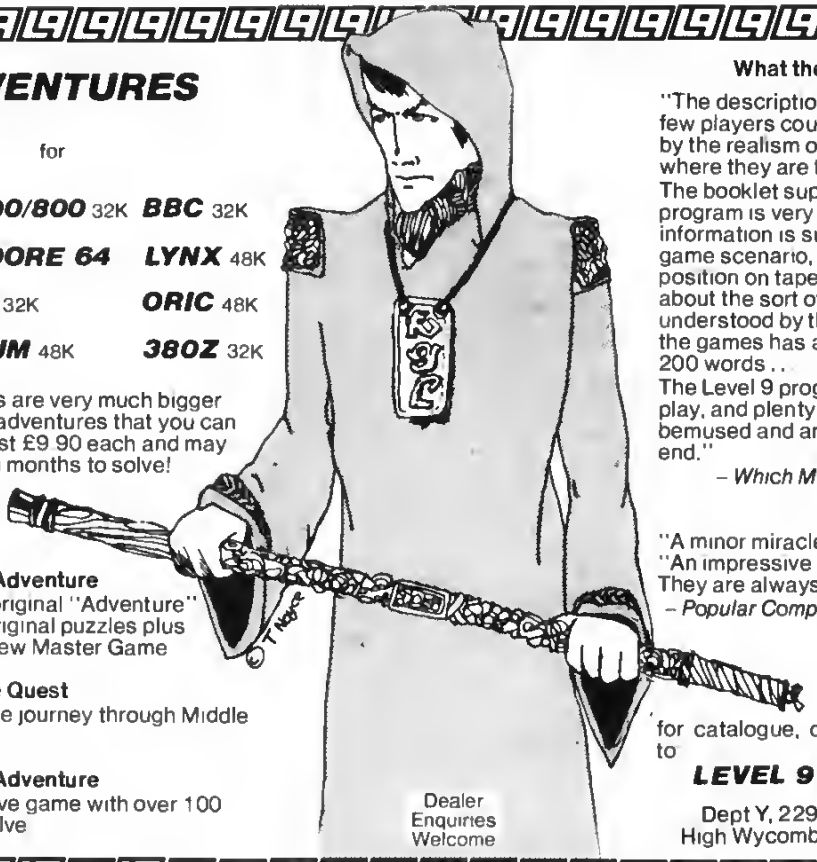
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– Which Micro & Software Review, August

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Local news

Aylesbury

The Aylesbury ZX Computer Club was one of the first to stage a public demonstration of the new Sinclair Microdrive. Other equally exciting events are planned. For details phone Keith Pyott on 0296 63087.

Merseyside

Once a fortnight the Mersayside Commodore Users' Group congregates at Maghull Deyes High School, Deyes Lane, Maghull, Liverpool. Meetings start at 7.30. Contact Mr J P Jones on 051526 4813.

Manchester

Not only TRS-80s but also Dragons and the burgeoning new wave of Tandy computers are catered for on the last Wednasday of each month at 8arton Aeroclub, Barton Aerodroma, Irlam, near Manchester. Telephone 0942 812843.

Southend

The Esplanade Hotel, Western Esplanade, Southend is the venue every Monday evening for the Southend Computer Society. Contract Robin Knight on 0702 21845.

Chadderton

Every Thursday South Chadderton Computer Club meets at Turf Lane Centre, Turf Lane, Chadderton between 7 and 9.30. For more information: Mr Jakeman, 26 Marble Street, Oldham, Lancashire. Telephone 061678 0547.

Darlington

Darlington Computer Club normally meets weekly, but events are less regular during the aummer. Technical librery is provided. Contact Leslie Boxell, 8 Vane Terraca, Darlington DL3 7AT. Telephone: 0325 467766.

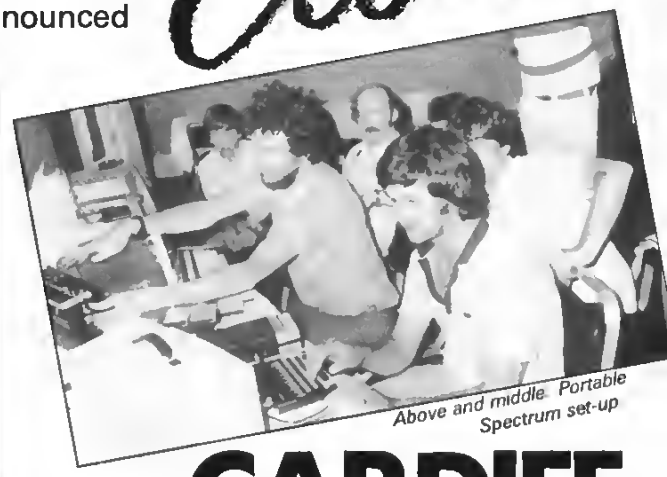
Southport

Tuesdays and Wednesdays weekly is when Southport Computer Club meets. Contact Ien 8nstone, 28 Weld Road, Southport, Lancashire. Telephone 0704 64524.

COMPUTER *club*

CARDIFF

Meirion Jones finds a welcome in the hillsides at Cardiff Computer Club where there is much excitement over Sinclair's recently announced Microdrive package.



Above and middle: Portable Spectrum set-up

TRADITIONAL WELSH dry Sundays have already been washed away in a tide of Brains Dark; Cardiff's local brew. Now choir practice and rugby training are under threat; this time home computers are leading the nation's youth astray.

On the last Sunday of every month up to 80 Sinclair enthusiasts turn up at the Central Hotel in Cardiff with their ZX-81s and Spectrums for the Cardiff ZX Club. There are now 120 members but back in November 1981 when the club started as The '81 club there were only two — Steve Smith and Mike Hayes.

The sudden growth of the club and perhaps over-exposure to adventure games has had strange effects on its founders. There is still no formal committee but Steve Smith says: "You can put me down as Emperor if you want".

Sinclair's Microdrive was the main topic of conversation at the meeting. Tim Gilberts who runs the Barry-based software house Gilsoft plans to write adventures that will take advantage of the 85K storage on each Microdrive cartridge.

David Bath who runs a small business in his spare time selling American science-fiction magazines is looking for more practical advantages. He originally bought a ZX-81 to help him with sorting out the orders. He soon moved on to a Spectrum and now finds that it takes two hours to organise which magazines go to which customers, compared with six hours when he did the magazine collation manually.

The Interface 1 will allow him to connect a printer to produce sticky labels, and with a Microdrive to store the information his whole task could be completed in minutes.



Below: Tim Gilberts demonstrates Gilsoft's adventrue writing Quill program



Cardiff ZX Club runs machine-code tuition sessions but the afternoon I was there was too hot for work. There was a different game on each of the 20 TV screens dotted around the room. Of the commercial programs Bug-Byte's Manic Miner seemed the favourite, also going down very well was Duncan Kinnaird's *Star Wars* game from our July issue.

The ZXers split long programs such as our Flight Simulator in December or our Submarine Mission in August into as many as six sections each of which is entered by a different member of the club.

The oldest member of the club is probably Henry Morgan from Llanrumney. But many of the members are as young as 12. Although many at the Sunday meetings are still at primary school there is also a mid-month session which is held in a fortress-like public house in Canton apparently for the sole reason of keeping out under 18-year-olds.

There are 5,000 home computers in and around Cardiff most of which are Spectrums. If you own a Sinclair and want to join the ZX Club you can contact Mike Hayes on 0222-371731.

For BBC Micro owners there is also the Cardiff BBC Users which meets on alternate Wednesdays — August 31, September 14 and so on — at University College Cardiff Mechanical Engineering Department, Newport Road, Cardiff. Contact Geoff Barker on 0222-701023.

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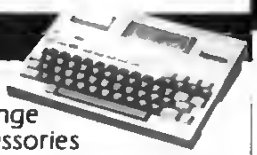
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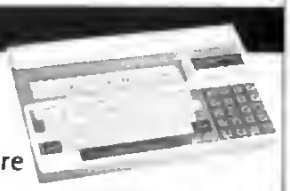


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Star chart

Maziacs

16/48K Spectrum: Novelty: £6.95: DK'tronics.

★ ★ ★

Blood-thirsty maziacs make your return trip to the adventurer's gold as uncomfortable as possible. For a successful outing you need plenty of swords, food and sound advice from the maze's hapless prisoners. Exciting, but luck often plays too large a role.

Orc Attack

Atari 400/800/1200: Novelty: £29.95: Thorn EMI Video.

★ ★

You defend your castle against hordes of orcs trying to scale the wall, fending them off with swords, rocks and boiling oil. They fight back with daggers and, if you are unlucky enough to be caught in the path of one, your head is severed. If you kill the orcs before they kill you the Sorcerer's spirits attack. If you survive that you have to slay the Stone Warts. I'd sell the castle. Good graphics and animation.

Vic Rescue

Vic-20 unexpanded: Shoot-'em-up: £5: Interceptor Micros.

★

The aim of the game is to release a rescue pod from the mothership and get the humans off-world having weaved through the asteroid belt. The graphics are unexciting and in space no-one can hear you scream. This explains why the only sound in this game is the noise of your spaceship crashing into an asteroid.

Star Jammer

Dragon 32: Shoot-'em-up: £7.95.

★ ★

In Star Jammer you manoeuvre your ship by joystick in order to get an alien ship in your sights, then shoot it down using your laser. Stargates are triggered automatically by beacons on your ship as you approach. Graphics are workmanlike and it is certainly tricky to keep the attackers in your sights.

SOFTWARE Shortlist

Terrordactyl

- *48K Spectrum*
- *£6.95*
- *Melbourne House*

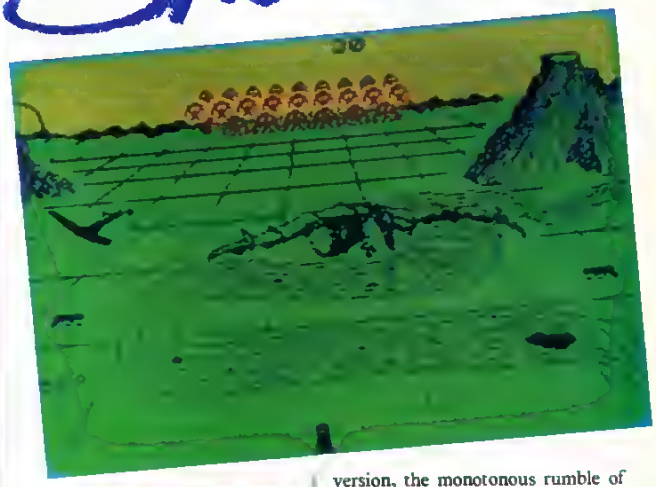
★ ★

SOME YEARS AGO Terry Dactyl and the Dinosaurs made their one mark on the pop charts. Unfortunately the tune was so much like Mungo Jerry's *In the Summertime* that now only Keith can still remember it was called *Seaside Shuffle*. Terrordactyl is likewise doomed because of its similarity to Space Invaders.

There is nothing wrong with the 3D graphics or with the setting. You are on a flight of Lost Jungle Airlines which crashes leaving you staring across a plain with a smouldering volcano on your right. You are armed with a tank-style gun which you fire at waves of invaders that come over the horizon and get bigger as they move towards you. Every so often a very life-like Pterodactyl comes screeching towards you and you must avoid it or kill it first time. If you can survive you are treated to a glorious sunset and sunrise and you go on to Day 2, Day 3, and so on.

But the game soon becomes tiresome, which is a shame because dinosaur mania has been sweeping the country since July when a 200 million-year old meat-eating fossil called Claws was discovered in a Croydon clay pit.

Claws may have been the most exciting thing ever to come out of Croydon but Terrordactyl is certainly not the most original program to come out of Melbourne House.



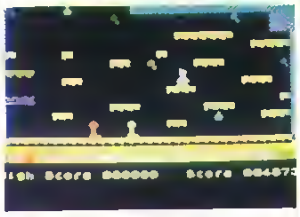
Manic Miner

- *8K Spectrum*
- *Bug-Byte*

★ ★ ★ ★

MINER WILLY stumbles on the riches of a lost civilisation while prospecting in Surbiton. Your job is to guide him back to the surface avoiding poisonous pansies, spiders and slime, and worst of all, the manic mining robots. Willy must also collect the keys which are vital to his escape to each of 20 lethal levels.

The game has excellent graphics, and keyboard control gives you plenty of choice as to which keys are most convenient for you to use. There is lots of wacky humour, too from the penguins in the cold room to the ferocious toilet seats in Eugene's lair, a witty side-swipe, no doubt, at one of Imagine's star programmers. Satire on other games also creeps in — Pac-Man lookalikes are to the fore in the processing plant and there is a Kong Beast and a Return of the alien Kong Beast. Not to forget the Attack of the Mutant Telephones — do not ring us we will ring you, eh, Llamasoft's Jeff Minter?



Games like this certainly make the average micro user of the paucity of imagination that less dynamic software houses are stricken with. What is the point of buying one game if so many elements of different arcade games can be so effectively combined? The animation is excellent. With games like this Bug-Byte will be laughing all the way to the bank — which occurs, in Manic Miner, on the 15th screen.

Submarine Commander

- *Vic-20*
- *£24.95 cartridge*
- *Thorn EMI Video Ltd*

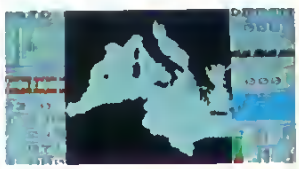
★ ★

FULL FATHOM FIVE thy father lies; of his bones are coral made: those are pearls that were his eyes. Yes, Dad's been at the Vic-20 submarine patrol simulator again, and, let's face it destroying all enemy merchant shipping in Mediterranean waters has never been an easy number.

This is a competent implementation of Submarine Commander, but lacks, in comparison with the Atari version, the monotonous rumble of engines throughout the mission and the colourful map. There are two main display screens; one shows a map of the Med with ships moving about, which you have to steer towards using the compass; and the other gives you a view through the periscope. You can also call up a sonar display when submerged, with a realistic pinging sound.

As you close in on the convoy they will start to bombard you — the screen shakes convincingly — and be careful not to get too close to the sea floor on the coastline, as this does not help your promotion prospects. Diving is also risky because too great a depth will fracture the hull causing wet feet all round. It is worth keeping your weatherbeaten old seadog's eye on the oxygen level, fuel, battery charge — most of you will be aware by now that diesel submarines run on batteries when submerged, and that the batteries are charged by diesel engines when snorkelling or running on the surface.

Submarine Commander has nine game variations, but not really enough new surprises occur to lift this one out of the merely good category. The occasional air attack would have been nice, for example. But the game is well thought-out: it is up to you to decide if it is worthwhile buying just another game at this sort of price, when you could more profitably buy a new peripheral — or maybe even another micro!





Sinclair's Microdrive promises fast mass storage at a price you can afford. Kathleen Peel finds out if this is the tape of things to come.

```
cat saved
kathy

cat
i/1
i/12
i/13
shell
ye1
ye2
ye3
zzzzzzzzzz

32
i/1        3 3
i/12       4 4
i/13       5 5
shell      0 0
ye1        2 2
ye2        0 0
ye3        3 3

done

zzzzzzzzzz10 10

zxc erased

cat erased
kathy

i/1
i/12
i/13
shell
ye1
ye2
ye3

30
stop
```

```
 1 REM AUIO FILE HANDLING SHELL
 5 SAUE &"m";1;"zzzzzzzzzz"
 7 LPRINT "zxc created"
10 OPEN #3;"m";1;"cat"
20 CAT #3;1
30 CLOSE #3
35 LPRINI "cat saved"
40 CLS : CAT #3;1
45 LET c=0
50 OPEN #0;"m";1;"cat"
60 FOR n=1 TO 9: INPUT #0;x$
65 LET c=c+1
67 IF c<3 THEN  NEXT n
70 IF x$="zzzzzzzzzz" THEN  GO TO 100
80 LPRINI x$;c;" "in
90 NEXT n
100 CLOSE #0
220 LPRINT : LPRINT "done": LPRINT : LP
RINT x$;c;" "in
225 ERASE "m";1;"zzzzzzzzzz"
227 LPRINT : LPRINT "zxc erased"
230 ERASE "m";1; cat"
235 LPRINT : LPRINT "cat erased"
240 CLS : CAT 1
245 CAT #3;1: LPRINT "stop": LPRINT
250 STOP
```

```
 1 GO SUB 9350: LET y=40: RESTORE
 2 DATA "
 30 LET a=0
 37 INPUT "print to screen y/n "1z$: IF
 z$="y" THEN  LET z=1: LET y=32: GO TO 1
0
 10 LET d=0
 102 READ a$: IF y=32 THEN  GO TO 106
 103 IF a$(1)=" 0" THEN  LE1 a$=a$(2 TO 1
: GO SUB 9360: GO SUB 9360: GO SUB 9350:
GO TO 102
 104 IF a$(1)="&" THEN  LE1 a$=a$(2 TO )
: GO SUB 9360. GO SUB 9350: GO SUB 9350:
GO TO 102
 105 IF a$(1)="z" THEN  LE1 a$=a$(2 TO )
: GO SUB 9360: GO SUB 9370: GO SUB 9350:
GO TO 102
 100 IF LEN a$)y THEN  GO TO 120
 110 IF a=1 THEN  PRINT a$: GO TO 112
 111 LPRINT a$
 112 GO SUB 100
 115 GO TO 102
```

```
120 LET a=0
125 IF a=y THEN  GO TO 150
130 LET h$=a$(y-c)
135 IF a$(y+1-c)=" " OR h$="!" OR h$=",
" OR h$="." OR h$="  " OR h$=";" OR h$="?
" OR h$=CHR$ 34 THEN  GO TO 155
140 LE1 a=a+1
145 GO TO 125
150 LET a=0
155 LET a$=a$( TO y-c)
158 LET a$=a$(y+1-a TO )
157 IF a$(1)=" " THEN  LET a$=a$(2 TO )
160 GO SUB 200
165 GO SUB 100
170 GO TO 100
180 LET d=d+1
185 IF d<22 TNEN  RETURN
150 PAUSE 500  REM  IF z=1 THEN  COPY
152 CLS : LET d=0: RETURN
200 LET a$=" "
205 FOR I=LEN a$ TO 1 STEP -1
210 IF LEN a$)y-1 THEN  GO TO 240
213 IF a$(I)=" " THEN  GO TO 220
215 NEXT I
218 GO TO 205
220 LET a$=a$[ TO I-1]+g$+a$(I TO )
221 LE1 I=I-1
225 LET a=a-1: IF a<=0 THEN  GO TO 240
230 GO TO 218
240 IF a=1 THEN  PRINT a$: RETURN
242 LPRINI a$: RETURN
999 REM  TIDY PROGRAM
1000 DAIA "": REM Enter filles to'he dele
ted here, then RUN1000
1001 DATA "zxc"
1002 RESTORE 1000
1003 READ a$: IF a$="zxc" TNEX  CAT #3,1
: STOP
1004 ERASE "m",1;a$
1005 GO TO 1003
9350 LPRINT CHR$ (30): LPRINT "58": LPRI
NT CHR$ (17): LET y=80: RETURN : REM set
 80 chars
9360 LPRINT CHR$ (30): LPRINI "51": LPRI
NT CHR$ (17): LET y=40: RETURN : REM set
 40 chars
9370 LPRINT CHR$ (17);CHR$ (23): RETURN
: REM change colour
9380 CLOSE #3
9381 FORMAT "h",000
9382 OPEN #3;"h"
9384 RETURN
9390 CLOSE #3
9391 FORMAT "t";000
9392 OPEN #3;"t
9398 RETURN
```

Program 1.

```
10 OATA '': REM Files for deletion
20 OATA 'zxc'
30 RESTORE
40 READ a$: IF a$='zxc' THEN GOTO 70
50 ERASE 'm';1;a$
60 GO TO 40
70 CAT #3;1: STOP
```

Program 2.

```
10 LET a$='kate'
20 IET d=49
30 LEt b$=a$: LET a$=a$+CHR$ (d)
40 SAVE *'m';1;a$
50 LET a$=b$
60 LEt d=d+1
70 IF d=110 THEN CAT #3;1: STOP
80 GO TO 30
```

SIXTEEN MONTHS after they were announced the first Microdrives are just being delivered. The price is still £50 for a drive which takes 85K tape cartridges instead of the 100K originally promised, but you can find and load a program in a few seconds. You will also need the Interface 1 before you can plug in up to eight Microdrives, but this interface gives you RS-232 and local area networks.

The Microdrive is housed in a box 90 by 85 by 40mm in size with an aperture at the front for loading the cartridge, and printed circuit board edge connections on both sides towards the rear. The right hand connector plugs via a flexible cable to the interface unit, if it is Microdrive 1 or plugs directly through a double ended socket to the next Microdrive. The drives are secured to each other by a plate underneath the housings. This should prevent the dreaded wobbles.

There are two small printed circuit boards inside which are without modification. The lower board provides the two edge connections, while the central vertical board houses a ROM and the tape head, which is used for both record and erase functions.

The mechanism is uncomplicated. The drive is generated by a rubber roller mounted directly on the end of the motor spindle. Pressure is applied by a leaf spring on the opposite side of the cartridge. The spring also maintains the cartridge position relative to the head, a very simple and highly efficient set up. My only worry would be head wear due to the abrasive action of the tape.

When the Microdrive is running, an LED indicator is lit. A warning is given not to remove the cartridge while this light is on.

The cartridge is claimed to be able to handle up to 50 files and have a minimum storage capacity of 85K. The two spare cartridges supplied for the review both had 90K of storage space available when formatted.

Typical access was very fast in comparison with cassettes but, human nature being what it is, you tend to notice when it is slower than usual. It can take longer to type in the load command than to find and load a short file.

The storage media is an endless loop of tape. The cartridge is very small 45 by 35 by 7mm., including cover and makes the opposition's 75mm. floppies seem huge in comparison. The cartridge can be write-protected in a similar manner to cassettes by removing a plastic tab, a piece of sticky tape will re-enable write.

I assume that before long we will be able to purchase S100 and S200's — Sinclair 200K — cartridges. In some applications it is quantity of storage rather than speed of access that is important. It will also be necessary to store the cartridges in a holder similar to those available for cassettes. The Sinclair hardware add-on industry is in business again.

Sinclair only supplies one blank cartridge per Microdrive, further cartridges are supplied singly with an order form for repeat purchases. Bearing in mind Sinclair's advice on the need for back up copies, it just is not sufficient.

It is possible to use strings for filenames in the Microdrive commands and variables for the Microdrive number. Because of the initial high cost of the cartridges, it makes sense to

REVIEW



ZX MICRODRIVE

produce the tidy facility shown in Program 1.

Program 2 was used to test tbe file storage capacity of 50 files. Three points emerged from the tests:

- Each file appears to occupy a minimum block of 512 bytes.
- As the limit of 50 files is exceeded, file names disappear from the catalogue in an apparently random fashion, but they still occupy space on tbe cartridge and are still loadable.
- Tbe average time taken to Save a sbort file in this manner is 10 seconds.

An attached Microdrive has no effect on the vast majority of commercial software. Only in one case where a program used interrupt control was a program found not to work, and I am not sure why not. If you open a stream to the Microdrive or Net then problems will arise, but if you do not try to use the Microdrive or try to Network a program then it sbould make no difference whatsoever.

The user is warned not to remove a cartridge while the Microdrive's LED is lit and not to switcb on or off witb a cartridge in the drive. This I continually forgot witb no apparent mishaps to the stored data.

I think tbe user would be wise not to leave a cartridge in the drive for long periods of storage, the pressure roller may take a permanent set and upset tbe tape transport.

I would have liked a protective flap over tbe cartridge entrace, not all drives will be used in a clean environment.

Tbe ZX Interface 1 was also announced in April 1982. It was simply called the RS-232/Network interface board and was expected to sell for £20. Since tben it has been expanded and now serves three functions:

- Microdrive controller
- RS-232 interface
- Local-area network

This little box of goodies is something special. There are flaws but it is still a very powerful addition to tbe Sinclair range of computer peripherals.

Surprisingly the two printed circuit boards in the Microdrive show no signs of modification whereas the printed circuit board in the interface has been altered. The board contains two integrated circuits, a prototype Ferranti LSI and an EPROM.

A Sinclair spokesperson has stated that tbe equipment delivered to customers will, in fact, contain proper production devices.

The interface plugs into the Spectrum rear connector and is attached through two existing screw holes to the underside of the Spectrum, the original screws may be discarded. A duplicate rear connector port is available on the interface as are the two 3.5mm. network sockets and the nine-pin d-shell connector for

(continued on page 55)

ADMIRAL GRAF SPEE by Simon Mansfield. Machine: ZX81 16K/ Spectrum 48K

GODZILLA & THE MARTIANS by Neil Streeter. Machine: ZX/ Spectrum 16K/48K

SPECIAL MISSION by Tony Frampton. T199/4A- extended basic

COBUS MAZE by Dave Gibson. Machine: VIC20 unexpanded joystick or keyboard

DUNGEONS OF DOOM by Simon Mansfield. Machine: ZX81/16K/ Spectrum 48K

MONOPOLY by Simon Lacey & Richard Fry. Machine: Dragon 32K/VIC 20 + 16K

TANK BATTLE by Tony Frampton. Machine: T199/ 4A-extended basic

BARON by Simon Mansfield. Machine: ZX81 16K/Spectrum 48K

HOUSE OF BUGS by Tony Frampton. Machine: T199/ 4A-extended basic

CHALLENGE by Neil Streeter. Machine: Spectrum 16K/48K

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Please cut here



(continued from page 53)

the RS-232 printer/peripheral interface.

Tbe Microdrive plugs into the exposed printed circuit board edge connector at the side through a flexible cable. The whole assembly is rigid and now the keyboard has been tilted, feels much easier to use.

The interface unit acting as the Microdrive controller, expands Sinclair Basic to include elementary file handling and communications commands. These are listed in Table 2.

The commands are created by paging the new ROM which creates an additional set of system variables. It looks from an cursory glance, that it is possible to re-vector the input-output routines used in both the Microdrive and Network channels.

The commands become a bit of a chore to handle after a while and you are soon driven to looking at producing your own simple operating systems.

Program 1 — tidy — is useful in containing the very rapid growth of a user catalogue. Program 3 — shell — is a means of handling the entire catalogue without coming up with the End Of File message and having unclosed streams and files.

Line 80 can be changed to provide whatever function the user wishes to apply to the catalogue. The printer outputs are not essential, they are there purely to aid fault finding.

The RS232 interface, which operates over a range of 50 to 19.2K baud with no parity, 8-bit character and two stop bits, should cover just about all but split-speed operation. Tbere are two modes of operation.

The t channel is normally used for listings. the control codes are not sent except for 13 — carriage return — and the tokeo ,codes are expanded. Tbere is oo graphic capability. These characters are replaced by code 63 (?).

The b channel sends the full 8-bit code and is used to send control codes to printers etc. Program 4 was written in order to produce this review and demonstrate the use of these channels. The Tandy four-colour printer has been used as the remote end of the RS232 interface, control codes are used to change to graphic and text modes, cbange pen colours and print size.

I can not recall ever having said that something from Sinclair was expensive, but £15 for an interface lead is a bit steep.

The ZX Net — local area network — promises to be a very powerful tool. Tbe network is set up by simply joining two Spectrum interfaces together with the 10ft. long net lead. The manual reveals a network operating at 100K baud with handshaking between two attached devices. Up to 64 Spectrums can go on the net.

Print station facility

There is also a broadcast facility to download information to anybody listening on the net. This would permit a teacher to broadcast a program to the whole class at once.

Other uses include the ability to set up a print station to service all the Spectrums on the net. Perhaps when Sinclair has managed to clone a few interfaces these properties can be evaluated.

The manual falls short of the usual high Sinclair standard due, in part, to the fact that it is not a derivative of an earlier work. Everything appears to be tbere but I think some of the text needs presenting in a much simplier form.

The demo tape contains a print server program, untested, and a poor-man's Horizons tape-a-data base-program which provides the meaning of tbe Microdrive commands from a database at what can only be described as slow, I was not impressed. ■



CONCLUSIONS

- The drives possess slightly less storage then hoped, they cost slightly more end they ere slower than expected. Nonetheless enother outstanding Sinclair buy.
- The interfece is e real gem. I know of some professional systems thet could not metch its performence.
- Together the devices heve worked without eny problems throughout the review period, e very good sign.

Table 1: Microdrive command format

LOAD* "M";1;"NAME"	The * indicates load from a microdrive
SAVE*"M";1;"NAME" LINE 10	Set name to run for autorun starup Lina optionel
VERIFY*"M";1;"NAME"	
MERGE*"M";1;"NAME"	Will not merge programs saved with a line number
ERASE"M";1;"NAME"	
FORMAT"M";1;"TITLE"	Title refers to a header for the cartridge

Table 2: Extended Basic commands

* Specifies a Microdrive function

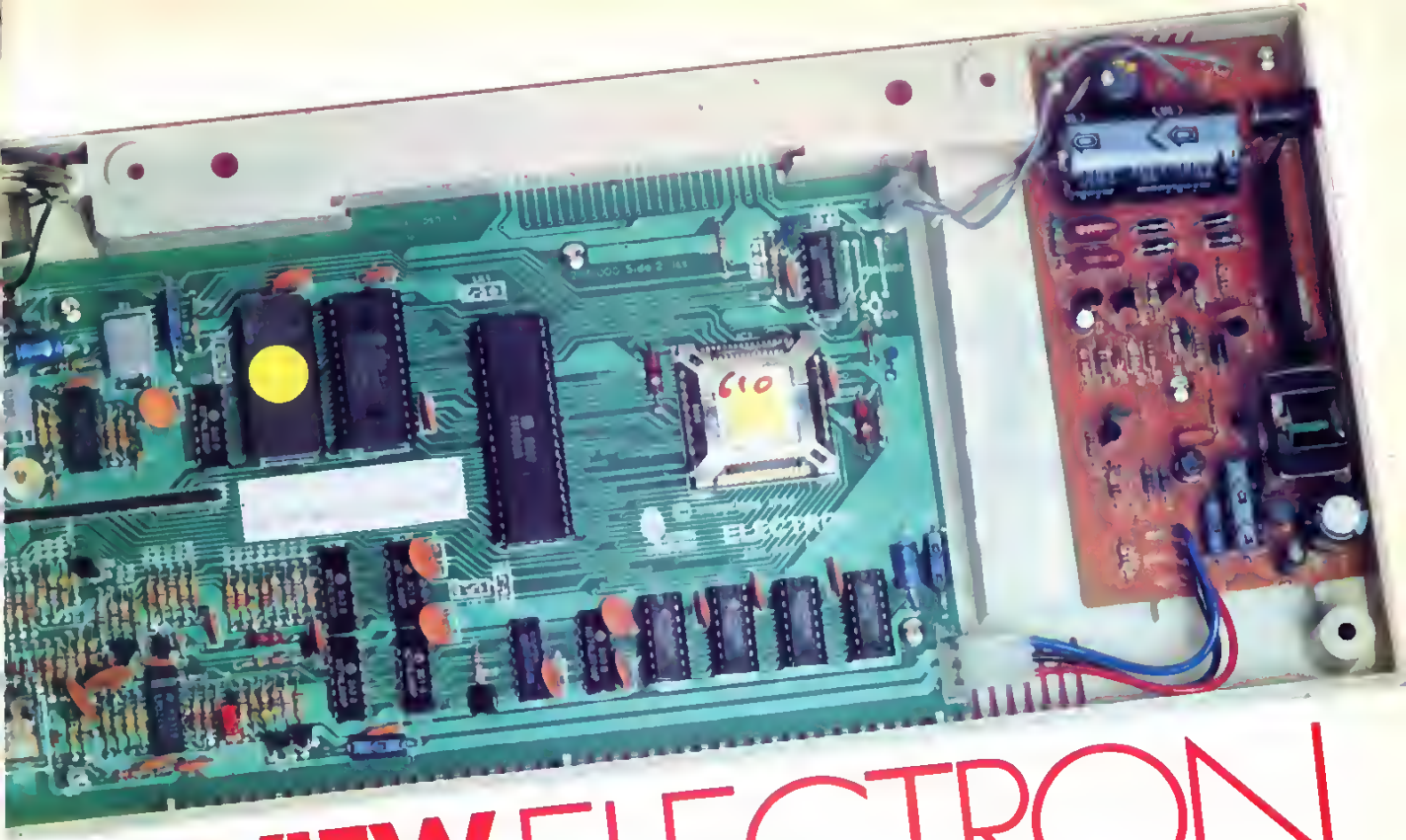
CAT Y	Y is Microdrive number 1 to 8
CAT #Z;Y	Z is stream number 0 to 15
CLOSE# Z	
ERASE"M";Y;"NAME"	NAME is a file name
FORMAT"M";Y;" TITLE"	TITLE is a name for the cartridge
FORMAT"N";X	N means Network and X station No. 0 to 64
FORMAT"T";S	T indicates RS232 text and S is the baud rete
FORMAT"B";S	B is for RS232 binary data
INKEY$ #Z	Return a characteer or null
INPUT #Z;Vat	Inputs e variable
LOAD * CHAN	Load prog, data or file from B M or N chennel, all other load options apply
MERGE * CHAN	
MOVE from TO dest	Only moves dete
OPEN#Z;CHAN	Links stream to channel
PRINT #Z	Outputs to specified stream
SAVE *;CHAN	Saves prog,date or code to B M or N channal only
VERIFY *;CHAN	

Channals: deta can be sent to various devices, your screen, ZX printer, microdriva file, another Spectrum on the same network end the RS232 interface. Data can be received from the following devices, the keyboerd, a microdrive file, another Spectrum on the same network and the RS232 interfaca. These devices ere known as channals

Streams: the routine from one channel to enother is called a stream, there are sixteen streams in the Spectrum system.



Dr. Neil Cryer looks at the Beeb's baby brother — the Electron micro from Acorn.



REVIEW ELECTRON

THE ELECTRON could not be made much smaller, yet still have a full-size keyboard. It feels solid: no flexing of the case, however hard you try.

It is light, yet feels as though it would stand up to very rough treatment. Also there are no holes for kids to poke things in; so it should go down well with schools. Although the Electron, at £199, is half the price of the BBC Micro it has a better keyboard.

The Electron comes complete with an ultra-large plug which houses the power supply. A thin, very long flexible lead connects it to a small socket on the right-hand side of the case. I find that I have to keep taking the knots out of this lead but there are no signs of trouble, after two months hard pounding. When you switch on the Electron makes a little beep which is reminiscent of the Beeb, but quieter, and a green light appears to the left of the keyboard.

On many occasions I have left the Electron on all day. Even in the tropical heat which we have been suffering recently, the power supply stayed quite cool. The Electron does get warm underneath but not hot.

The Electron plugs in to a normal television or to a colour or black and white monitor. Three suitable sockets are supplied on the left of the keyboard.

The cassette connection is via a 7 pin DIN socket to the left of the keyboard. The signals here are at the same levels and with the same connections as for the BBC Micro. This means that any cassette recorder set up for the Beeb will plug straight into the Electron and load with no problems. The motor on the tape recorder can be controlled from the Electron, just as with the BBC.

When plugged in, the Electron produces the welcoming message on the screen:

Acorn Electron
BASIC

There is also a little symbol of an acorn at the end of the first line. Then the Electron sits waiting for your words of wisdom, either via the keyboard or the cassette connector — also on the left.

The Basic on the Electron is debugged BBC Basic. It is particularly noteworthy in that it positively encourages clear, structured programming. You will find it quite effortless to remove Gotos from programs and replace with such things as Repeat — Until loops, For — Next loops and procedures. Thus, the long variable names and the multi-line procedures and functions mean that your programs should soon become super-clear. You should find that you — and even other people — will be able to understand how your programs work, even months later.

Comprehensive user guide

The Electron comes with a readable and comprehensive user guide. It is well written but would benefit from an index. Also provided is an introductory cassette — which holds a number of demonstrations and games, together with a language called turtle graphics. This language is used extensively in another handout with the Electron: a short book entitled *Start Programming with the Electron.*

Entering programs for the Electron is particularly simple for one-finger typists. The tops of the keys are marked with the usual typewriter symbols. However, on the fronts of the keys, you see, clearly printed, a whole set of Basic words such as For on the F key and Next on the N key. If you put one finger on the function key and then press one of these keys, you get whatever Basic word is printed on its side. This special feature is called single-key entry. For most people, it will save a lot of time and typing errors and will clearly be a boon. Touch typists will probably prefer to type everything out in full, which is also allowed.

As an example of single-key entry, suppose you press the Func key together with the D key. You get the message Draw on the screen as part of the current program line or instruction. You can add to this by typing on the keyboard or, indeed, you could erase all or just part of it by pressing the Delete key, if you so desired.

The number keys double as user definable function keys. So, if you would prefer some other message to appear on the screen as a result of a single key entry, then you can program one of the number keys to cause this. Any of the number keys can be defined to do a variety of things. For example, a single key press could be made to enter the instructions Renumber and List one after the other. Some people using the Beeb, which has similar keys, have entered whole programs as a key definition. This can be particularly useful for editing with the various programs which have been published for such purposes. The number keys still give the numbers if pressed without the function key.

The screen display for the Electron is exactly as for the BBC Model B, with the exception that mode 7, the teletext mode, is

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not available. The Electron starts up in mode 6 with 25 lines of 40 characters to one screeen. There are seven screen modes, numbered from 0 to 6, giving you from 20 to 80 characters per line, with either 25 or 32 lines per screen. Most of these modes allow mixed graphics and text in a number of colours. This is just the same as for the BBC Model B with from 2 to 16 colours, 8 steady hues and 8 flashing. The compromise between resolution and number of colours is the same as with the BBC Model B with mode 0 giving a resolution of 640 pixels by 256 in two colours while mode 2 gives 160 by 256 pixels in the 16 colours.

If you are not content with the standard character set of ASCII characters you can always define your own. By printing one character in one colour in the same place as another, you can also get multicoloured characters. Schemes for doing this for the Beeb have been published and they will work in exactly the same way for the Electron.

The Electron is slower than the Beeb — about 2/3rd the speed. There is no doubt that this must be a disappointment to the games software writers. Within the speed limitation, though, most games for the Beeb should still work on the Electron, provided they don't use mode 7 and don't try to scroll the screen sideways.

The Electron uses a massive ULA to do almost everything. This includes doing all that the 6845 video chip did in the Beeb. A impressive design this, going much the way Sir Sinclair did with his ZX breed. There is no screen blanking while loading from cassette, just a message giving the current block number being loaded and the program name.

You will see from the photograph of the inside of the Electron that there are very few chips. The main one which catches the eye is of course the ULA. There are 64 connections round this chip. When you think that the majority of the functions of the Beeb are also performed by the Electron you realise also that the masses of chips inside the Beeb have been replaced by this one ULA.

The sound on the Electron only allows one channel at a time. This is disappointing and means that you cannot produce BBC-style music. You can program the envelope of a note in terms of how the frequency should vary while the note is sounding. It is a pity that you cannot also program the amplitude as with the Beeb. Although you can still get most of the usual laser gun and other games effects, you will not be able to produce the Beeb's imitations of various musical instruments.

The sound is produced on one of three tone channels with a fourth for noise. Each channel has been arranged with a different priority. A note on channel 1 will cut off a note already sounding on channel 2, whereas a note on channel 2 will have to wait for any sounding on channel 1.

Basic programs load into memory at address E00, just as for the Beeb, and the memory map for the Electron looks very similar to that of the Beeb. All the relevant VDU, *FX and machine code call points are implemented as for the Beeb. By relevant I mean that some of the specialised VDU options for the BBC Micro, which addressed the 6845 chip, cannot work on the Electron as the ULA now replaces the 6845. The codes for turning on and off the printer are a little superfluous without a printer connection, but when a printer expansion is added, then presumably these will work normally.

This brings me to the assembler. The Basic includes a 6502 assembler, allowing all 6502 op codes and addressing modes, and it can be addressed from within a Basic program, just as for the Beeb. This now includes the use of Equs for storing strings directly in memory, Equb, Equw and Equd for byte, word and double word storage — 4 bytes at a time. These are a very welcome addition for assembly language programmers and make such programming very much simpler. Macros will still have to be implemented via functions or procedures as described elsewhere in the literature for the Beeb.

Now for the features that the unexpanded Electron does not have. These include sideways ROMs; so software such as View, Beebcalc and Beebpen will not work unless you are willing to unplug the Basic ROM and plug in the other ROM instead — which does seem to work. Even this will probably not be possible in the future, as the Basic and operating system chips sit on a little daughter board plugged into one socket. It would seem fairly clear that the intention is to replace the daughter board eventually by one 32K ROM.

According to Acorn, the following, which are well-known in connection with the Beeb, will be available for adding to the Electron externally:

Disk interface
Tube interface
Econet interface
RS423
Printer port
User port
Analogue input
Sideways ROMs

All these will presumably be connected via the 50 way connector on the back of the Electron. There are two brass bushed screw connectors either side which look purpose-made for the very substantial bolt-on expansion system which Acorn is already talking about. No details are available at the moment, but clearly there will be an immediate market for them.

CONCLUSIONS

- The Electron offers almost all of the same programming facilities as the BBC Microcomputer.
- There will be plenty of software for the Electron because of the close compatibility with the BBC Microcomputer.
- The Electron will be expandable.
- At £199 it is more expensive than some people had hoped. Nevertheless, it should sell well because of the reputation earned by its big brother. ■



CBM 64 SOFTWARE SURVEY

MIDNIGHT SOMEWHERE on Terra. I was slumped on a contour couch watching the late show when a World Government announcement suddenly broke in: "All pilots with Gridrunner experience report to joystick port two immediately". It could mean only one thing — the droids were back! The other thing that it might mean, however, is that the *Your Computer* reviewer is space-happy.

As hardware, the Commodore 64 is certainly value for money. With its 64K of onboard RAM — of which 38K is available for Basic programs — a choice of 16 colours and two character sets including predefined graphics characters, plus a fully-fledged sound generator there is no doubt that it is a very appealing machine.

No messing about with 3K or 16K RAMpacks to avoid irritating out-of-memory errors. It plugs straight into your monitor — no PAL modulator required.

But as yet, the software houses seem to find the CBM 64 a positive *embarras de richesse.* Sadly one is left feeling here is a host of rapidly re-implemented Vic-20 programs aimed at cashing in quickly on the new market. It also seems that the machine's larger memory is paradoxically a handicap, permitting lazy programming with extensive use of Basic routines which make many 1K ZX-81 games exciting by comparison.

Melbourne House's Super Cassettes A and B contain plenty of examples of the latter syndrome. The idea is sound. Two bumper-bundle games cassettes backed up by a separate Commodore 64 games book written by Clifford and Mark Ramshaw, containing the actual listings. As an introduction to computing it is reasonably sound. Any book written by two siblings so apple pie-eyed as to dedicate it to "Mom and Dad" cannot be all bad. But there is still room for improvement.

Documentation accompanying the cassettes is wrong in one or two places — always more dispiriting for a newcomer to computing than one long inured to the slings and arrows of outrageous fortune. On Super Cassette A many cats and dogs fell to their doom while I figured out which keys would actually move my catcher left and right. They are M to go right and Z to go left. Rest assured, Cliff and Mark have got it right in their book.

All in all, this is potentially a neat introduction to computing for someone who has never seen Luna Landa on a ZX-81, or who enjoys the rare pleasure of being able to lie back, relax, and have a cup of coffee in between launching occasional rocket salvoes at some of the most cautious and diffident UFOs yet to attempt encroachment on Earth.

Audiogenic's Motor Mania brought a much-needed release from these psychological frustrations — a taste of the open road, albeit somewhat lacking in clear resolution. You participate in a cross-country car rally beset by drunken drivers, potholes, road patches, broken glass, logs, cross-traffic and avalanches. It may not get BSM approval, but it is often the unexpected things that catch you out in a driving test. This is an absorbing test of your reactions but the instrumentation on the right hand side of the screen could surely have been presented with a better definition.

The other CBM 64 offering from Audiogenic is Renaissance, repottedly the full-function, computerised version of the age-old game of Othello. This is not my favourite game and I was still waiting eight minutes later for the computer to make its first move. I guess the CBM 64 is not over-keen on it either.

But it certainly did not get the hump about Attack of the Mutant Camels from Llamasoft. Written by Jeff Minter this at least sounds as though it might be original, although in another life those camels could well have been Imperial AT-AT walkers. Enough of this speculation. In a scenario that, had it been made into a SF movie in 1952 would probably be showing late nights in independent West End cinemas, the Earth is threatened by kidnapped camels, mutated into 90-foot high laser-spitting neutronium-shielded monsters.

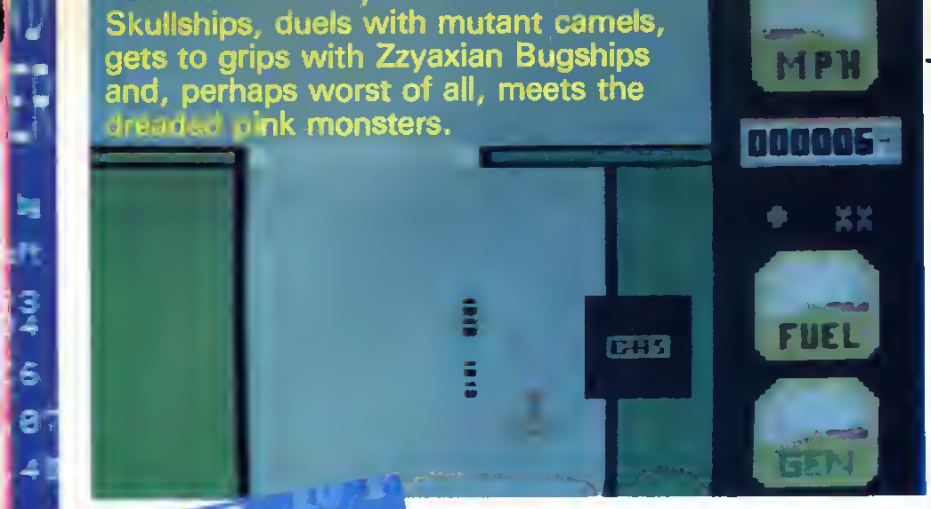
The neutronium means that not only can the deadly dromedaries hand it out, they can also take it so you have to be pretty persistent as well as nippy when manoeuvring your rebel snowspeeder, sorry, spaceship around their nobbly knees. As you remorselessly pump your shells into them, they gradually change colour and disintegrate. At least it's better than cold-harpooning whales. Good graphics, remorseless sound effects, this is a fine shoot-'em-up game.

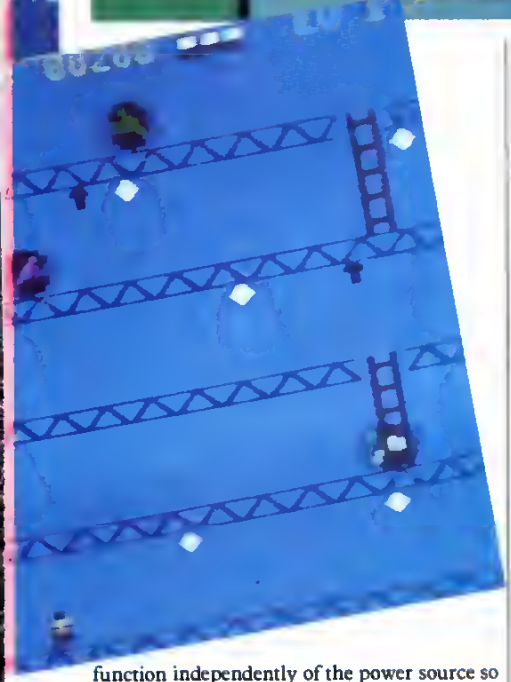
On a musical note, Irving Berlin once said to Cole Porter, "Listen, kid, take my advice, never hate a song that has sold a half-million copies". Likewise, you should never hate a game that is number one in the U.S. popularity stakes. Such is the lot of Minter's best-known baby, Gridrunner, and its even faster offspring, Matrix, is no doubt following in its footsteps.

For those of you who did not serve in the first lot the infamous Grid Wars broke out when alien droids were discovered to be infesting the Earth's vital energy grid, sapping our power. As you probably gathered from the opening paragrapb, I was right in the thick of those early battles, zipping around, zapping away with my plasma cannon at the linked droid segments. God, it was bell.

Back then, they traversed the grid horizontally. Pods would lodge on the grid gradually evolving until they hurled a bolt of energy downward. Then there were the X-Y zappers running along two sides of the grid. Their crossfire was what formed the pods, and was very likely to be the end of you if you got caught in its way. I still wake up in a cold sweat thinking about it.

But the return of the droids necessitated the formation of the crack Matrix squadron. Things are no easier. The new ship can





function independently of the power source so you are not just confined to the bottom seven lines of the grid. But now there is a fifth column. Watch out for the Snitch — the treacherous humanoid who runs along the top of the grid giving your position away.

How could anyone ally themselves with fiends who use such bizarre psychological warfare tactics? Sometimes camels appear and run down the grid. Argh. These tend to reduce your score. Deflexor waves make your projectiles ricochet off.

Worse, there are diagonal waves of droids — they are no longer confined to trundling back and forth across the matrix. Seven mystery bonuses can be scored, but it is down to you to find out how. Answers on the back of a £5 note to the Spaceman's Rest and Rehabiliation Centre, please.

After all this excitement, Laser Zone comes as a bit of a let-down. It is not particularly interesting visually or aurally. You have to manually co-ordinate two cannons on X and Y axes as Iratain Skullships and Zzyaxian Bugships slide towards the sides of the screen. As the battle progresses rabbitrons, cosmicats and maniac mice show up, and some swear to seeing a camel.

However, the Iratian death satellite does make an entrance and, like the mutant camels, it is coated in neutronium so it takes a bit of blasting since it is well-nigh impregnable.

Also well-nigh impregnable was the documentation for Anirog's 3D Time Trek. Perhaps starship captains really are smarter than spacefighter pilots. They need to be when the manual says things like press D for damage report when it means Ctrl D. You are given no clues as to how to get the galaxy map up. In fact it is M. Still this is apparently a prototype starship.

It is the usual Star Trek format but you get visual acquisition of Klingons flying towards you — a chance for a bit of shoot-'em-up after all that cerebral chart-reading. A competent implementation.

Interceptor Software's Star Trek does not have quite the same pleasures of interactive fighting, but it does give you an option of three types of game scenario: Klingon Invasion, Galactic War and the Final Frontier. The instructions and controls are wonderfully convoluted in the best tradition of Star Trek, but one feels that the sound potential has not been fully realised.

However I should confess that while testing this implementation I was dismissed from Starfleet for genocidal war crimes against an alien civilisation.

The company serves up a reasonable implementation of Scramble which, instead of that rather obscure manoeuvre of bombing fuel dumps to get more energy, has you destroying the forcefield projection dishes which stop the energy being beamed to you from the mothership. Much more plausible.

Interceptor's version of Pac-Man holds no surprises but is certainly a fast enjoyable game. The gulper was not very responsive to the joystick so I should stick to keys on this one. The monsters all have names like Zippy, Stilty and Gippy. There is one rather indolent blob called Chris. Zippy is pink and relentless — as devotees of previous software reviews will know, a pink monster is always very, very nasty.

There are nasty monsters in Panic 64, also from Interceptor. Standard Panic format — only instead of digging a hole in the masonry to cause the pursuing blobs to fall into oblivion, you have to place a time-bomb. This has the rather disconcerting result that they can still bump you off if you misjudge the length of your fuse. There is a fundamental logical flaw in the game insofar as it is quite possible to hang things up by blowing two or three holes in various levels and then standing there while the monsters fall into a loop. This is a no-win situation. Apart from this it is well-implemented.

Crazy Kong — diamonds are a girl's best friend and your job is to collect a load of them at the same time as you are avoiding the barrels that the insane simian is rolling down from the top of his steel fortress where he is holding your girlfriend captive. Apart from assuming that you are male this program also assumes that you can figure out the keyboard version for yourself. Following the documentation, I was crushed to death several times pressing 3 to jump before I discovered you had to press the Ctrl key as well. As for jumping when you hit the spacebar forget it.

For the intellectuals among us, there is always what is described as the world's strongest chess program for home computers. Grand Master from Audiogenic is well-documented.

You can have response times from five seconds up to several days. The latter is for postal chess although, if your brain is as slow as mine, it is quite a useful option. But since the original version of this game will run perfectly happily on a Vic-20, perhaps we can look forward to even stronger programs in the future.

In conclusion, it must be said that the CBM 64 is not yet well served by the software houses, who seem to be in a creative rut. Documentation on many games is atrocious which is one reason that utility programs have not been reviewed here.

So we must look to the future. People who have seen the Chromasonics 3D football game for the CBM 64 at micro shows will believe that great things are possible although development problems made it impossible for them to let us review the game. The advent of Simons Basic will further enhance the machine's capabilities — and the first software house to really use this facility or, indeed, any of the real 64 potential will make a lot of money. But for now, if you are thinking of buying a CBM 64, my advice is don't. In a few months time there will be good software around, and the machine will be cheaper ■

Company	Program	Price
Anirog 8 High Street Horley Surrey	3D Time Trek	£5.95
Audiogenic PO Box 88 Reading Berkshire	Renaissance Motor Menie Grand Master	£8.95 £8.95 £17.95
Interceptor Lindon House The Green Tadley Hampshire	Panic 64 Scramble Spriteman Crazy Kong Star Trek	£7.00 £7.00 £7.00 £7.00 £7.00
Llamasoft 49 Mount Pleasant Tadley Hampshire	Attack of the Mutent Camels Gridrunner Metrix Laser Zone	£7.50 £5.00 £7.50 £7.50
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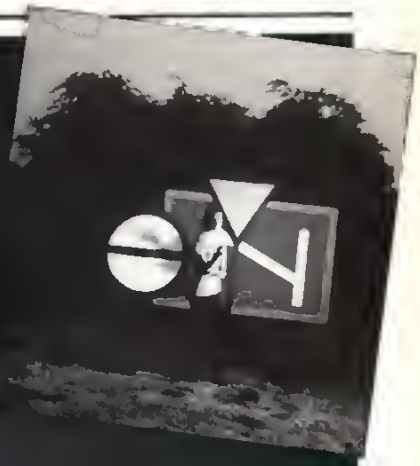
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If you answer "Eh?" to these questions, then it is definitely time that you found your way into computer adventure gaming; and rather than spend £25 or more for a decent ROM cartridge, or something less for what is often something very much less, maybe you ought to know just how easy it is to devise your own adventure storylines and develop them into simple programs that will give you and others hours of fascination, triumph and exasperation.

Unlike the genesis of Space Invaders — it was, you may remember, that dear little game of ping-pong played on an oscilloscope which Willy Higinbotham, an American physicist, invented as a lab entertainment in 1958 — the birth of the computer adventure game or CAG is badly documented. But it undoubtedly grew from some idle programmer's search in the mid-1970s for a text-orientated pastime that he could play when nobody was looking — loosely based on the Dungeons and Dragons concept that was sweeping the United States.

```
1 REM CROWN OF ATLANTIS
2 REM GRID & COMPASS MINI ADVENTURE
3 REM COPYRIGHT JOHN RANSLEY 1983
4 PRINT CLS CP
5 REM SET TERRAIN
10 DIM L 10 10
15 REM MINE FIELD
20 MR=2
49 REM ZERO GRID
30 FOR I=1 TO 10 FOR J=1 TO 10
40 L I J =0
50 NE I J
55 REM SITE RUINS
60 FOR I=1 TO 6
70 READ R C
80 L R C=1
90 NEXT I
95 REM SITE CORAL
100 FOR I=1 TO 6
110 READ R C
120 L R C =2
130 NEXT I
135 REM SITE FEATURES
140 L 2 3 =3 REM FISH
150 L 3 7 =4 REM WHALE
160 L 5 7 =5 REM WRECK
170 L 9 1 =6 REM SPIRE
174 L 7 4 =7 REM SQUID
175 L 8 6 =8 REM MALMOR
180 L 6 5 =9 REM CROWN
200 REM FIRST POSITION
210 R=INT RND(1 *10 +1
220 C=INT RND(1 *10 +1
230 REM MAIN LOOP
```

(listing continued on next page)

Like Higinbotham's ping-pong game, the early CAGs were a kind of cult entertainment that only the knowing tab-collars at IBM and Sperry Univac could play — until the day in 1978 when one of their number, by the name of Scott Adams, sent his mainframe buddies into peals of laughter by revealing his intention to scale down an adventure to fit his TRS-80 with all of 16K.

The rest, as they say, is history. Scott Adams went on to become the author of some wholly original CAGs whose themes have provided the stuff of plagiarism for pale imitators — but his Adventureland, Pirate's Cove, Mystery

(continued on next page)

(continued from previous page)

Fun House and The Count are among the classic originals.

All are well worth playing as examples of inventive and imaginative programming before you try your own hand. Adams is also rightly credited with inventing the puppet, but more about that later.

So what exactly is adventure gaming? In essence, it is a mapped conundrum; an unfolding story, often having a mythical theme, in which you, the player, find yourself in different locations and presented at each with a choice of actions and/or objects, with the ultimate objective of finding hidden treasure, rescuing an imprisoned maiden, slaying a dragon, or whatever.

For example, Adventureland — the Scott Adams title that started it all, and now available in ROM cartridges for many popular micros — involves a trek through increasingly hostile countryside in a quest for hidden treasures. Pirate's Cove, another Adams scenario, takes the player from a London flat on to three other locations; it introduces some particularly strong characters and plenty of humour. The Count sets the challenge of finding a way through the corridors and cellars of Dracula's castle with the aim of staking him out before sunset.

Lateral or 3D routes

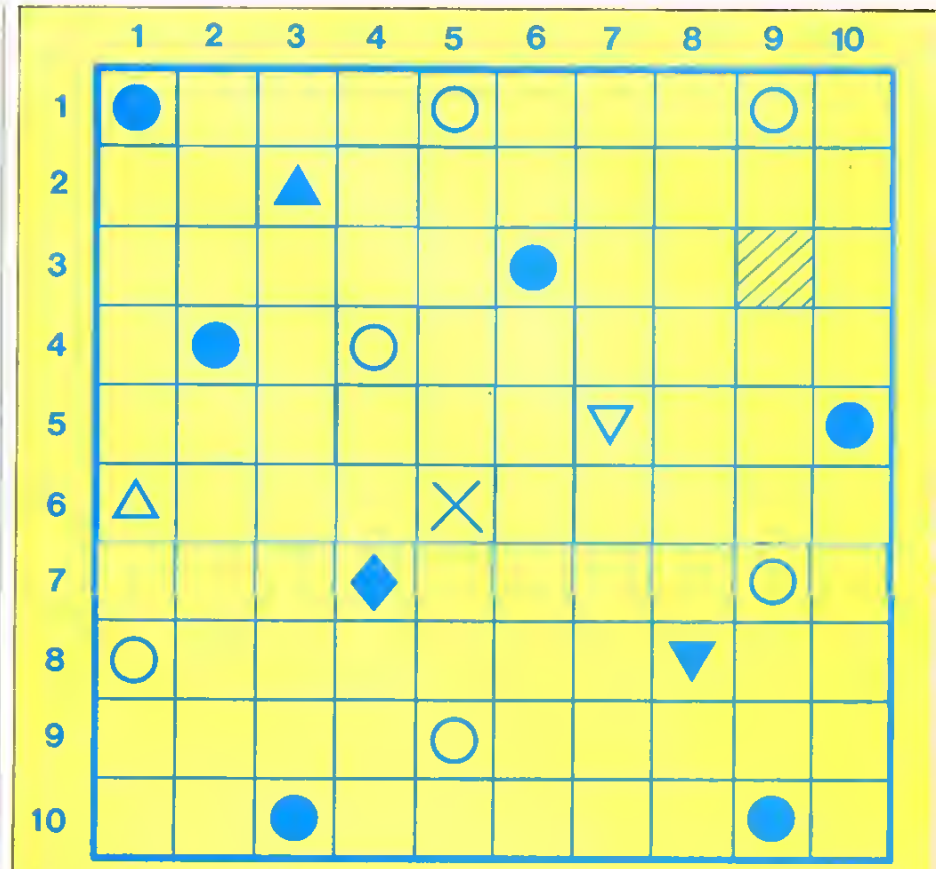
From these brief descriptions, you will understand that the routes or playing boards of most CAGs are either lateral, in that they cover several different locations — for example, from a museum to the shores of a secret island, and from there to a magic waterfall — or three-dimensional in the sense that they require the player not only to travel from one room or chamber to an adjacent one, but also to explore different locations of the same building, structure or tomb — such as in House of the Seven Gables or Pyramid of Doom.

Three-dimensional adventures can be very much more complex to conceptualise and flow-chart — and on-screen improvisation is not recommended when writing CAG programs — so novices will probably find it easier to cut their teeth on devising a conventional lateral scenario to begin with.

Adventure writers would argue that one of the best reasons for trying your skills at programming this kind of material is that it involves, in an attractive way, all the main building blocks of Basic; variables and string handling, string-chopping and concantenation, randomising, If-Then and loop logic, screen presentation, and — if your micro runs to even limited colour and sound — the optimisation of simple graphics and sound effects.

In short, adventure-game writing can serve as a valuable refresher course in good programming manners — and this also applies, of course, even if you are already into machine code

There are some notable exceptions to the rule — Melbourne House's innovative Hobbit is one of them — but most CAGs usually sacrifice, for purposes of memory economy, the highly colourful and animated screens of action games such as Frogger or Pac-Man in favour of a screen display comprising simply two or three sentences providing information and inviting or suggesting a response. For example, one screen might read:



(listing continued from previous page)

Figure 1.

```
440 PRINT"[CD1]YOU ARE DIVING
450 SO=L*R (C-1)
460 ON SO GOSUB 270 280 285 290 300 310 320 330 340
 GOTO 360
270 PRINT"[CD1]OVER CLEAR SEABED." RETURN
280 PRINT"[CD1]OVER STONE RUINS" RETURN
285 PRINT"[CD1]OVER PINK CORAL." RETURN
290 PRINT"[CD1]NEAR A SCHOOL OF FISH." RETURN
300 PRINT"[CD1]NEAR A WHALE SKELETON." RETURN
310 PRINT"[CD1]NEAR A SHIPWRECK." RETURN
320 PRINT"[CD1]ABOVE THE SPIRE OF
321 PRINT"ATLANTIS" RETURN
330 PRINT"[CD1]NEAR A GIANT SQUID!" RETURN
340 PRINT"[CD1]NEAR AN OLD ANCHOR" RETURN
350 REM YOUR MOVE
360 P=RND(5)+C
365 PRINT"[CD]WILL YOU SWIM"
366 PRINT"N , E OR W"
370 GET M$ IF M$=""THEN 370
380 IF M$="N" THEN P=P-1 GOSUB 400

390 IF M$="S" THEN R=R+1 GOSUB 400
400 IF M$="E" THEN C=C+1 GOSUB 440
410 IF M$="W" THEN C=C-1 GOSUB 440
420 GOTO 530
430 REM COMPASS ERROR
440 SO=INT RND(1 *10)+1
450 IF SO<4 THEN RETURN
460 IF SO=1 THEN C=C+1 RETURN
470 C=C-1 RETURN
480 SO=INT RND 1 *10 +1
490 IF SO<4 THEN RETURN
500 IF SO=1 THEN R=R+1 RETURN
510 R=R-1 RETURN
512 REM OCTOPUS RISA
514 PO=INT RND(1*10)+1
515 LO=INT RND 1 *10)+1
516 IF R=RO AND C=CO THEN PRINT "[CD1]ORSON THE OCTO
    PUS HAS GOT YOU!!!" GOTO 64
520 REM FOUND CROWN?

530 IF RC
540 IF LO
    VE FOU
GOTO 640
560 GOTO 2
570 PRINT"
580 RR=INT
590 IF RR<
    640
600 M$=M$+
610 PRINT"P
620 PRINT"P
640 PRINT"D
650 GET G$
660 IF G$=
670 PRINT"D
680 PRINT"D
690 END
700 DATA I
710 DATA I.
```

The castle gate is locked.
The ground is soft.
There is a spade nearby.

It is almost inevitable that you would type in:
Take spade
and hit Return. The screen might then prompt:
Now what?
and you may command,
Dig ground.

The pairing of a verb with a noun to make a character string that matches, somewhere along the data line, with those verbs and nouns you have seeded in the program is usually, but not always, the essence of all but the simplest adventure writing.

It merely exploits your micro's ability to interpret and act upon the Left$, Right$, Mid$ and Val functions, and this technique will be described in detail in the second part of this article, in next month's issue.

For the moment, it would not be a bad idea, as part of beginning to visualise your own adventure, to start jotting down in a notebook a selection of those short, useful verbs. Here are some of the most popular to get you thinking: North, south, east, west, up, down, go, enter, open, close, push, pull, get, take, move, steel, unlock, drop, give, trap, pocket, hide, follow, eat, swallow, drink, chase, capture, hit, break, attack, slay, look, examine, help.

These are fairly mundane verbs. More imaginative choices may in turn suggest novel actions and confrontations to work into your plot. Anyway, all of them are self-explanatory, with the possible exception of the last three.

The Look instruction serves as a request for more information about a particular location, if any exists. Examine performs the same function in respect of an object. A typical

The variables.

L	Location
M	Mine
RO	Row number of octopus
CO	Column number of octopus
R	Row number
C	Column number
SO	Square currently occupied
RS	Row number stored
CS	Column number stored
M$	Move
RR	Mine random risk



negative response to either might be, from a puppet,
I see nothing special.

Finally, Help is a real cry from the heart, to be used only when the player is really stuck. Use of this prompt at any point will usually call up on-screen a clue that will help to make a right next move.

Incidentally, those of you fortunate enough to number a voice synthesiser among your peripherals will readily appreciate the scope for its utilisation as a adjunct to, or substitute for, screen text displays.

The use of puppets

A word about the puppet mentioned earlier. When Scott Adams had completed his first few adventures, he discovered that some players found the practice of having to communicate through a keyboard with what they anyway perceived as a characterless, soulless chip rather too sterile an experience by half.

So the clever fellow hit on the idea of the puppet; an extension of the player — and maybe even of his *alter ego*. The puppet addresses his master, the player, in the first person, so a puppet version of the last example might read instead:
The castle gate before me is locked.
The ground I'm standing on is soft.
I can see a spade nearby.
What shall I do?

Because the language of puppet screens needs to be a little more human, and can thus be rather text-heavy and byte-hungry by comparison with conventional screens, such programs need to be even more economy-conscious.

But puppets are definitely more fun, especially if you give your puppet character strengths and weaknesses of his own, and have him talking back and complaining, C-3PO fashion, about the mess you have got him into when you have made the wrong response.

Just in case all this talk of verb/noun twinning, data matches, string chopping and insolent puppets puts you off adventuring any further, there are some perfectly respectable and highly entertaining commercial adventures which make use of one or two much simpler techniques — the option menu and C and G, or compass and grid. You can learn them easily and write programs utilising them very simply.

Compass and grid

With the option menu, at every significant stage in the adventure the player is presented with, say, three choices of action — he may pick just one of them. Using again the earlier example, the screen might read:
The castle gate is locked.
The ground is soft.
There is a spade nearby.
Will you
1. Turn back?
2. Take spade and dig?
3. Look around?

The player would respond by simply touching key 1, 2 or 3. In this case, option 1 might get him eaten by the monster he did not notice standing behind him. Option 2 could result in the screen announcing that he has dug his way into a patch of quicksand; while option 3 may reveal that there is also a ladder nearby which will let him climb *over* the gate.

One of the big advantages of the option menu, relying as it does on single-key responses such as 1, 2 or 3, or Y or N, is that, of course, it utilises Get rather than Input statements and thus avoids the need for the player to hit Return after keying in every response — a particular advantage when children are playing.

As we can all be clumsy or careless at times, it is an easy matter to program in a mug-trap that will flash up an error message on-screen and let the Run dwell until a correct key is pressed.

The second, even more fundamental technique and one that can be used together with the menu option, is that of the compass and grid — it is really just a crib from the old battleships game using squared-off paper that some of us played as kids. With this, you actually have a little map of the main location or locations — the cellar of a haunted house, say, or a treasure island.

This hard copy is copied into the program with the use of a simple two-dimensional array — the number of rows in the grid being one of the Dim subscripts, the number of columns being the other — together with read and data statements. The program also holds the



locations on the grid of any special features and, of course, that of the object or whatever is the subject of the search.

Because C and G programs are so simple, even the meanest memory has plenty of bytes left over for embellishments such as graphics and sound effects. There is no reason, for example, why your hard copy of the map should not instead be interpreted as a colourful screen display; while winds can howl and monsters can growl as the game proceeds.

When you hit Run, one of the program's randomising lines will place you on a square in the grid. You do not know which one, but make an educated guess from the clue shown on the screen and from comparing this with your copy of the map.

Each screen will invite you to move N, S, E or W — meaning one square up, one down, one left, or one right. Simply touching one of those four letters on the keyboard completes your move and generates the next screen display — which you hope will contain another clue to your new location and its proximity to the treasure square.

It would hardly be fair to compare a C and G game with a full-blown Scott Adams adventure, but it does make an excellent starting point — an infinitely variable challenge to which you can add all kinds of bells and whistles in the form of interesting graphics, animation and sound — rather than fill up your RAM with overdressed routines or wordy screen displays that may be called into use only once every nth game.

Apart from that, byte-busting adventures that can go on for hours may be all right for the Dungeons and Dragons freaks, who I imagine sprinkle energy pods on their cornflakes, but for newcomers to the genre, and especially kids, their frontiers of boredom are likely to be reached within about 10 minutes.

Further, it always makes sense to start simple — and devising and writing a C and G program allows you to do just that. It will be by no means a wasted exercise, because virtually every new trick you learn and mistake you make will serve as an invaluable template of experience when you come to tackle the writing of a CAG proper.

So for now, you will find here the listing for The Crown of Atlantis — a compass and grid program that will start you playing, and thinking, along the right lines. Although written for a Vic-20/Commodore 64, it will run on computers using almost any other dialect of Basic

(continued on page 72)



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Peter Connor finds a few gold nuggets in the software swamp

ADVENTURE SC

FAR AWAY AND LONG ago in the mists of the past, or so the legend goes, the Boffin grew weary of the needs of his faceless master. The boffin craved the excitement of strange landscapes and exotic beasts, the challenge of using logic and luck to succeed in a complex and perilous task. So he created the Adventure, transforming himself from a weedy nine stone computerkid to a musclebound warrior or an ancient wizard or a bold spaceman. Or whatever he wanted. So the legend goes.

The reality is that there is now a plethora of adventure games available for the micro-owners, all descended from this original idea. They all claim to offer you, "in the comfort of your own armchair", the thrill of entering a fantasy world which you can only get out of alive by using a combination of logic and magic.

Adventures require rather more tenacity than the usual game since they are rarely solved in one sitting. The player also needs a high frustration threshold as one of the principles of adventures seems to be W C Fields' motto "Never give a sucker an even break"; you might go back the way you came, but you will not necessarily get back to where you came from.

Level 9's Colossal Adventure, for the BBC



micro, shows how a good adventure should work. It claims to be based on the original mainframe game and, if the loading time from tape is anything to go by, this may well be true. It is worth the wait though. This program demonstrates one of the essentials of an enjoyable adventure; an interesting and detailed topography. There is a great variety of locations and objects, from the picnic area with some tempting sandwiches — should I eat them? — to the room where you find a gilded cage and the magic, but inpronouncable, word XY22Y.

The object of the game, as with so many adventures, is to find and collect a number of hidden treasures. This in itself sounds rather uninteresting, but in Colossal Adventure it can become a compulsive quest as frustration is outweighed by desire to crack the puzzles.

There is even a touch of sarcasm in some of the computer's comments. If, in a blank moment, you decide to kill something — a fancy that seems to come up on most adventure players at some point — you will be admonished "Are you mad? You should only kill your enemies". Suitably chastened, you try once again to summon enough brain-power to find those elusvie treasures.

Lack of inventiveness

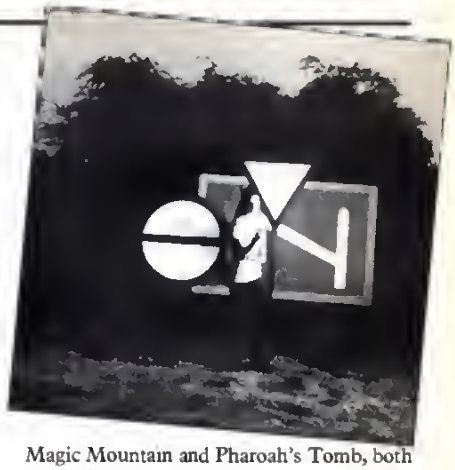
Also for the BBC, Acornsoft's Countdown to Doom is, unfortunately, not up to the Level 9 level. Anyone who has played Acornsoft's Philosophers Quest, a game of comparable quality to Colossal Adventure, will be very disappointed. There is a lack of inventiveness and wit in Countdown to Doom which makes it just a little bit dull.

Here, you are an astronaut in your crashed spaceship. Your task is to find the wherewithal to repair it and make good your escape. Initially you encounter a blocked door, the answer to which seems to be the explosive and fuse you see lying on the floor. Once you are outside you encounter a depressingly familiar adventure game landscape; the evil-smelling swamp, the steaply-climbing track, the jungle, the glacier. It is all so uninspiring that you do not really care where you end up next.

Sphinx Adventure, also from Acornsoft, is rather better, but not much. The locations are familiar, but are described in slightly more detail. There is the forest, the sorcerer's lair, the sword chamber, and so on. One or two odd characters make an appearance, such as the axe-throwing dwarf and the bearded pirate, but do not really justify their presence.

There is quite a choice of adventures for the Spectrum, most of them rather uninteresting. One of the better games, but dull nonetheless, is Bug Bytes' The Castle. In this you have been condemned by a nasty old wizard to collect six treasures or remain forever in his domain. Although the locations are not described in any great detail, they are reasonably interesting. There is, for instance, a Black Chapel in which stands a statue of Medusa; a passing aquaintance with Greek mythology should be enough to make you wary of petrification.

Diamond Trail, from Gilsoft, is another tolerable game for the Spectrum. The drawback with this one is the in-joke location; you are in Spectransia and must find the Sinclive Diamond. Once you have got over that the game itself is not bad. The locations are quite interesting — police HQ, a junk shop, a tube station — and there is even a touch of wit; when you are hungry you are tricked into entering the command Eat Cat, to which the computer replies "I wouldn't touch it with a barge pole, let alone eat it!" It is not a great belly-laugh, but in the land of adventures you have to make the most of everything.



Magic Mountain and Pharoah's Tomb, both from Phipps Associates for the Spectrum, introduce a graphic element into the adventure; each new location is represented by a drawing made before your very eyes. Sadly, the finished drawings are of little interest and take so long to complete that they would have been better forgotten.

You must gather treasure

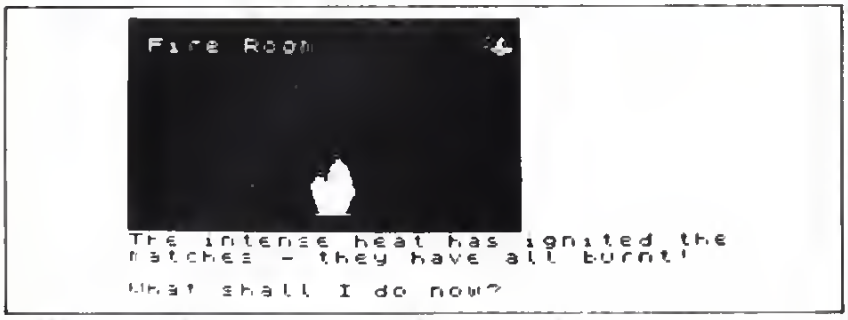
In other respects, these two programs are straightforward adventures. In Magic Mountain you seek the mystical scroll of wisdom hidden deep in the chambers of the mountain. Fortunately, there are some pleasing moments on the trail. At one point you encounter a dwarf with a stall whose sign says "Scythes sold and Fortunes told". My advice is to buy something and ask a question, despite his disgusting habit of cleaning his nails with a curiously shaped dagger.

Pharaoh's Tomb is a very similar game. This time you have to gather treasure at an oasis. When you want to push a rock, you may

(continued on page 70)

SOFTWARE SURVEY

COMPANY	PROGRAM	MACHINE	PRICE
Level 9 Computing Dept Y, 229 Hughenden Road, High Wycombe, Bucks, HP13 5PG.	Colossal Adventure	BBC	£9.90
Microdeal, 41 Truro Road, St. Austell, Cornwall.	Jerusalem Adventure Williamsburg Adventure	Dragon Oragon	£4.75 £4.75
Severn Software, 5 School Crescent, Lydney, Glos.	Holy Grail	Oric	£6.95
Pase Software, 213/215 Market Street, Hyda, Cheshire.	Adventurelend	Oric	£4.99
Bug Byte, Mulberry House, Canning Place, Liverpool.	The Castle	Spectrum	£6.95
Gilsoft, 30 Hewthorn Road, Barry, South Glamorgan	Diamond Trail	Spectrum	£4.95
Phipps Associates, 99 East Street, Epsom, Surrey.	Magic Mountain Pharoahs Tomb	Spectrum Spectrum	£4.95 £4.95
W. B. Soft, 191 Seamer Road, Scarborough, N. Yorks.	Adventure 1	Spectrum	£5.95
Anirog, 26 Balcombe Gardens, Horley, Surrey.	Zok's Kingdom Pharaoh's Tomb	Vic 20 16K Vic 20 16K	£5.95 £5.95
Wintersoft, 30 Uplands Park Road, Enfield, Middx.	The Ring of Darkness	Dragon	£10.00
Acornsoft, 4a Merket Hill, Cambridge, CB2 3NJ.	Countdown to Doom Sphinx Adventure	BBC BBC	£9.95 £9.95



(continued from previous page)

be asked "Are you sure you want me to risk having a hernia?'

W B Soft's Adventure 1 is an exceptionally dull program in which Steve Silver has to find and repair his captured spacecraft. There is no detail to the locations, for example, "I'm in a forest". OK, but what kind of forest? I would like to know. Not a hint of humour enlivens this boring game.

Zok's Kingdom and Pharaoh's tomb, two games for the 16K Vic from Anirog, are examples of a recent development in adventure games. Both have a mixture of the usual adventure features and tasks where you have to move your graphically represented player to avoid, or fight with, enemies.

According to Anirog's blurb, these games test your speed and ability to think and plan under pressure. If you had the body and brain of a tortoise they might just do that. By trying to combine the action game and the adventure game Anirog have fallen heavily between stools; what you get is a dull adventure with dull graphics.

Wintersoft's The Ring of Darkness, for the Dragon, suffers from similar drawbacks. It starts like a conventional adventure; "Four Rings the Ancient Wizards forged and cast against the earth. One ring the evil sage called forth from the void . . ." and so on, in sub-Tolkein view. You can choose your character — elf, dwarf, or human — and the skill you want — thief, warrior or wizard.

Then, however, the format changes. A map appears, on which your position is represented by a Z. This you manoeuvre with the cursor keys. With tedious frequency you encounter bandits and evil rangers with whom you must either fight or flee. Little else seems to happen in this so-called enchanted land; you need none of the usual adventure skills of logic or lateral thinking.

Adventures in Jerusalem

Microdeal has a series of adventures on the market for the Dragon. Jerusalem Adventure is set in the ancient biblical city and is, thankfully, a conventional adventure game. No graphics here. You have to find nine hidden treasures while out-manoeuvering Arabs that will kill you if you enter their quarter of the city. This is an unpleasantly racist note in what is otherwise a laudable attempt to put some new life into the adventure game location. You are advised to be religious at the Western Wall. Pray a lot. Say magic words. Some of the objects encountered are lost through a lack of convincing detail of the locations.

The Dragon, of course, is closely modelled on the American Tandy Colour Computer, and this transatlantic influence is prominent in Microdeal's programs. Williamsburg Adventure will be mystifying to most British players since it relies on a knowledge of, and interest in, American history.

If you do not know or do not care what William and Mary College or Scribner's are then you are not going to have much fun playing this game. This is unfortunate, because Williamsburg Adventure has its moments of wit and interest. But if software houses are going to market American products, they might at least ensure that they are comprehensible to the old world consumer.

Severn Software's Holy Grail for the Oric barely qualifies for inclusion in this review. You are, supposedly, looking for the Holy Grail in the castle. This latter, though, appears on the screen as a grid around which you can move horizontally or vertically. You might get bonuses of gold or wound salve, or you might meet zombies, orcs or wolves; never fight, just run. There is no detail or challenge in this game.

Adventureland is a Pase Software game for the Oric and is, happily, more like the real thing. Although there is again a lack of detail, the game is at least cryptic and intriguing, requiring a certain amount of deductive skill to achieve anything. There are magic words and undiscovered creatures — be careful, they might bite.

Getting a raw deal

You might think that, given the limitations of the machine, it would not be worth writing an adventure for the ZX-81. Bug-Byte has, however, produced the not very originally named Adventure. You must look for the missing three pieces of the Royal Sceptre, put them together and return them to the Emperor. The game is, of course, fairly rudimentary, but when you bear in mind what some of the games for more sophisticated machines are like, it is not so bad.

At the moment adventure game fans are getting a raw deal. Of the programs reviewed here the only one that is wholly admirable is Level 9's Colossal Adventure. Too many games rely on a borrowed scenario without trying to add any original elements. Why so many dwarves and wizards? Why not an adventure set contemporary Britain with cops and robbers or skinheads and greasers? Why not just about anything but the boring old forest, swamp and dungeon? Shabby graphic displays do nothing to better a dull game. What software houses must find now is writers with a little imagination. ■

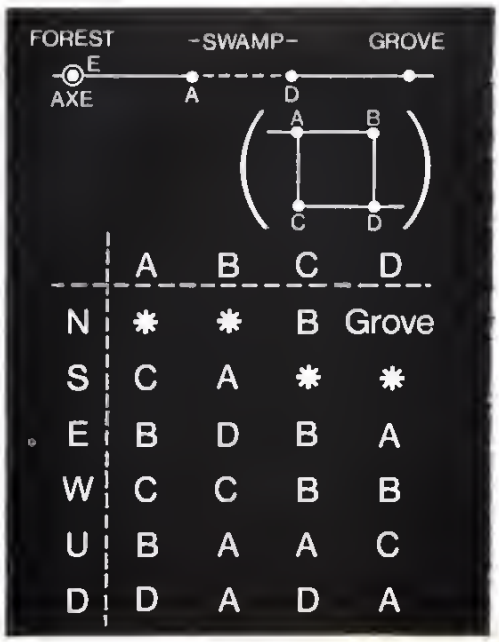
HOW
ADVE

YOU HAVE BEEN STARING at the screen since midnight, the rest of the house has gone quiet and there is nothing but the sound of your black coffee going cold for company That and the dragon of course.

The dragon's been sitting there eyeing you from behind the television. It has been a steady war of attrition since you stumbled into the cave about an hour ago, before then you did not know about being driven back by scorching flames. You have learnt a lot in the last hour. First you tried throwing in the onion in the hope it would cry out its flames — brilliant! . . . it swallowed the onion . The sword then, the sword! . . it swallowed the sword too. . . . So now you are sitting here glaring across a keyboard at a dragon that has systematically eaten everything you ever owned and wishing that you'd never agreed to swap your old invaders cassette.

Dealing with the dragons

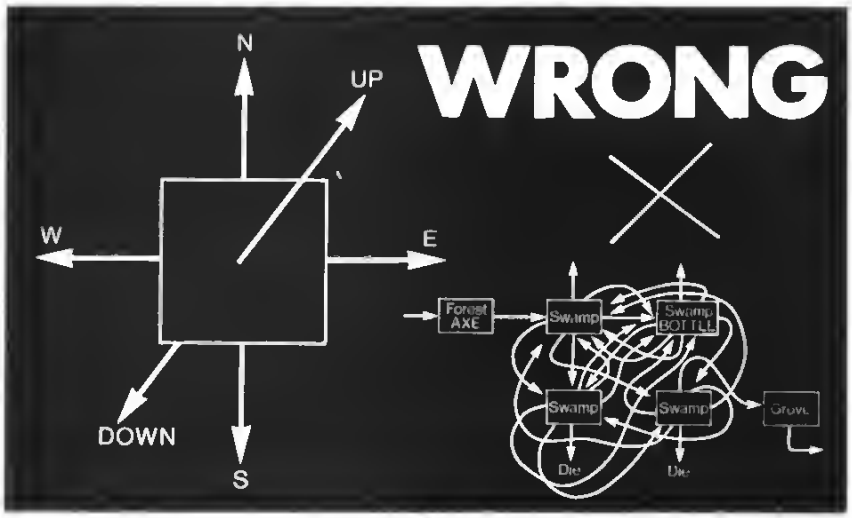
If someone had not got bored with batch processing on a mainframe it might never have started, but once the first adventure game had been written there was no stopping them or the growing band of addicts patiently awaiting the latest releases Since they first became available, adventures on micros have become both better at understanding what you type, and larger and more varied in their scope At the same time writers have been inventing



TO SOLVE NTURES

Nigel Hubbard explains how to cheat the monsters and recover the treasure.





ever more tortuous puzzles to perplex you So you are quite likely to come to a halt faced with something that you are convinced is impossible Especially if it is your first adventure

This is where the fun starts though When you have woken the house after getting past your first tricky obstacle you'll know what I mean So that you do not have to learn everything the hard way here are a few tips for dealing with dragons and their friends



If you often find it hard to retrace your steps, you get lost a lot and you have not got a clue what this place you are wandering around looks like then you are probably a bad mapper You get them everywhere scribbling on the back of their seventh envelope and scrabbling around for the map of the last room they got killed in To be a good mapper start by getting some nice big bits of paper, keeping one or two for the total map and the rest for working out what this new area you have just found really looks like You may need to redraw the whole thing or jump to another part of the sheet when you reach the edge but, obvious though it sounds, you will be surprised how much more fun it is not having to search for scraps of paper and knowing exactly how the whole adventure fits together. If you get into these good habits you will race along until suddenly you are lost in a steaming swamp and directions do not see it to make sense anymore

Maze mapping rules

At first mazes can seem pretty pointless. You go east then west but you are not back where you started So you panic and go up, down, in, out, north, east, south and west and you are still lost in a steaming swamp. Do not give up though, there are quite a few tricks to save you from starting at the beginning again and sloshing through by trial and error, and when you have finally cracked the maze it looks very impressive to be able to run through it without giving it a thought

The first rule is to walk into the maze carrying as much as you can Wear everything that the computer will let you, put things in your pockets if possible and then just start dropping one thing in every new place you come to Now instead of everywhere looking the same you will start to be able to get your bearings Going east from the bottle takes you to the elephant, going west, to the Lamborghini and so on If you are drawing a map of a maze like this then you will soon see that there is no point in trying to make sense of the directions themselves Just put a dot for each location and simply draw one line between each pair that are connected writing the relevant directions at each end This will be good enough to get you through most mazes

The real puzzles

In some mazes a simple map is not enough though, as before long it will start to look decidedly wayward and weblike The trick here is to draw up a table similar to the one shown here For each new location that you find, add a new column in the table headed by the object that you have dropped there Then down the side list all the directions in which it is possible to go Now it is a simple task to systematically fill in the body of the table with the names of the objects that you reach by going up from the sword say.

You are now in the same position as everybody else when you arrive at the swamp. Beware though! As always, things will never be quite as they seem. The writer may have decided that people are getting a little too complacent and the first thing you will notice is that the golden ball that you were sure you dropped around here has been stolen. Then things start getting tough again and if when you drop your first object it sinks into the swamp with a gurgle and disappears, take a deep breath because you are on your own.

Now that mazes seem altogether less threatening we get back once again to the dragons of adventure games the real puzzles that they were set for in the first place. If you are expecting me to tell you what to do when your spaceship is rushing towards an asteroid or when your schooner is about to be marooned off Easter Island or simply why you keep dying when you attack the Dobermann Pinscher then you have the wrong idea already You are the one who is going to solve all of those problems and more before you have finished If you have a mental block then go and look round another part of the adventure or better still go and make yourself a cup of coffee. Then you will be ready to attack

(continued on page 72)

(continued from previous page)
the problem properly.

Now write down everything you have come across that you cannot explain yet: things and places, remembering that even an object that you have used and broken, such as a bottle that you have had to smash, may have needed to be used elsewhere as well. Now in any good adventure there will be some reason for everything being there. The chewing gum may not look much use, but what about the old dragon, everyone knows you can't swallow chewing gum. So go off and try it, you never know; and even if it does not work it will have been a good idea. Making connections like this, often the obscurer the better, is the key to finding the way to a solution.

If the adventure has been written properly then even if you have finally solved something by trial and error, you ought to look back with a wry smile and wonder why it had not been obvious to you a few minutes ago. A bit of inspiration now and then should be all that you will need. If the overall game or a particular section reminds you of a book then it is worth looking it out and reading what really happened in *The Hunting of the Snark* or how Pooh beat Piglet at poohsticks. Perhaps it suggests a film or even a painting, you never know what the writer might have been alluding to and an extra clue never does any harm. As with the objects that you find lying around do not assume that the description of a room is just there for setting the scene. You never know when someone is trying to tell you something. Keep an eye open for any bad puns as well.

Many games available

If you follow all those ideas you should stay on the move for a bit longer than before and not mind so much when you get stuck. Luckily for us all, there are a lot of games available. In general, with adventures even more so than with video games, you get what you pay for. Buy adventures that exploit the full memory of your machine, that way not only do you get more to explore but the computer is more likely to understand you when you try to do something. Generally the more work that has been put into writing the game the more fun it will be to play; a good one is worth the extra.

Finally, the future is written on disc. The opportunities for writing adventures with plenty to explore, describing everything you see in detail and being able to make the computer far more intelligent at understanding commands, are just too tempting. Never believe people who tell you that they are saving up for drives because they are fed up with loading programs from cassette; the true reason is that they have their eyes on some disc adventures.

Acornsoft among other companies will be expanding its range of adventures to include large games especially written for disc. With the added scope for original ideas that these will offer, the next few years should be an exciting time for players. I hope, at least, you have been tempted now either to start adventuring or to go back and solve the puzzle that had you beaten. You will be glad you did. Good luck with the dragons! ■

WRITE YOUR OWN



(continued from page 65)
with only minor alterations. For example, almost every micro has a slightly different syntax for creating random numbers, and that used in this listing may not work with a Dragon or Spectrum.

To help you get this program up and running fast, the program does not include lines of text on how to play — you may like to add these when you adapt the program and jazz it up with your own refinements. But this is what the game is all about.

In The Crown of Atlantis, you are an aqualung diver searching a particular area of the Atlantic's seabed beyond the Straits of Gibraltar, for the legendary underwater city and its greatest treasure. You have memorised the grid map shown in figure 1 and therefore know the locations of coral growths, ruins and other notable features, such as a whale's skeleton and the famed Spire of Atlantis, by which you can reckon your position

You move around the seabed by touching one of the keys N, S, E or W. You will be told whether you are in a clear area or close to one of the features that will help you to get your bearings, and then be invited to move again.

There are, however, three obstacles to the completion of your mission. First, the strong currents may force you in a direction slightly different from that which you intended; this is a random factor and so you can never be completely sure that you are not, in fact, where you hope you are!

Secondly, equally random is the hiding place of a particularly irascible example of the *Octopus Vulgaris*, who will draw you into his ring of tentacles in seconds and from which there is no escape.

Thirdly, you risk overshooting the area of seabed represented by your 10 by 10 square grid, in which case the screen will show a warning to this effect.

But if you do overshoot there is, initially, a one-in-five chance that you will swim straight into an unexploded wartime mine, which will at least provide the octopus with a convenience food. The second time you overshoot, the risk of blowing your mine precisely doubles. The third time you make this error, you have virtually no chance of surviving.

By studying the program, you should be able to work out how to increase, decrease or vary these hazards and factors, or introduce new random elements. If you have a TI$ or time function, then you can add to the diver's problems by giving him only a fixed amount of time to find the treasure before his air supply runs out and so on.

You may also choose to make the whole game much more difficult by randomising the location of the actual treasure — just check out the program logic to identify which lines you need to change and how.

When you feel that you have exhausted all the possibilities which The Crown of Atlantis offers your micro, why not get to work dreaming up your own idea, using this first program as the bare bones of your own imagination and ingenuity.

Line 10 first reserves a 10 by 10 array representing the playing grid; in future tbe first subscript in the brackets will signify the row number and the second subscript, the column number.

Lines 30 to 50 fill all 100 positions with an initial value of 0, representing a blank square, or clear seabed. Lines 60 to 90 award a value of 1 to each of the stone ruin locations specified by the data in line 700 — where, for example, the second pair indicates that a stone ruin has to be sited in row 3, column 6. Lines 100 to 130 serve the same purpose in respect of the coral locations, drawing on the data in line 710.

Lines 140 to 190 fill seven more locations, one subscript pair at a time, with other features, including the location of the treasure.

Lines 200 to 210 generate a random row and column for the grid position occupied at the beginning of each game. Screen prompts are triggered by lines 240 to 340, depending on the L or location value acted upon in line 260. Line 360 stores the current row and column for the next update.

Get rather than Input is used in lines 370 to 410 to avoid having to hit Return after choosing every turn. Incidentally, touching any other key will, on the Vic-20 anyway, simply freeze the move and not crash the Run.

The routine in lines 440 to 510 introduces a randomly-occurring deviation in the direction of movement, plus or minus one square. Lines 514 to 516 generate a random position for the octopus and compare this with the player's current location. The off-course message is triggered by line 530 — and may in turn trip lines 580 and 590. Otherwise, line 600 amends the risk factor for the mine set in line 24.

Alternatively, line 540 detects if the current position matches that of the Crown of Atlantis and if so, branches to the play option in line 640. Or if the current position is neutral, line 560 loops back to line 240 for another turn ■

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The Hobbit. More of an experience

' After a very short time I found that 'The Hobbit' was becoming almost a way of life rather than a game, and so when I finished it for the first time I was partly sad because I felt that all the fun and adventure had ended, but I was wrong. Even now I am discovering new things about the game and feel that it will be some time until all of its secrets are revealed to me "

MR. J. STERN, Herts

"I have at last received your 'Hobbit' program and would like to congratulate you on its excellence After four days of sweat and tears I have completed only 37 5 per cent of the adventure The program has lived up completely to expectations, and there is no doubt about it being the best production for the Spectrum to date You have surpassed all others w[illegible] program."

' A lot of fun "

COMPUTI[illegible]

'The excellent gra[illegible] The exciting differ[illegible] is that it is possibl[illegible] converse with all t[illegible] meet and ask their[illegible] recommend this g[illegible] Tolkien or novel a[illegible]

POPULAR COMP[illegible]

"I am writing to c[illegible] 'Hobbit' I think it is one of[illegible] ingenious programs I have h[illegible] to use. It has kept me stump[illegible] months I think the effort th[illegible] has go[illegible] writing a program like this must have be[illegible] enormous The effects are brilliant to say th[illegible] least "

JEREMY CHESTER

[illegible]bit takes first place in the new [illegible] quality and value for money. '

SINCLAIR USER

[illegible]cations in the Adventure are [illegible]e excellent graphics. Wi[illegible] [illegible]mplete 7.5[illegible] of [illegible]

[illegible]ures The [illegible]ied plot [illegible]erior to any [illegible] for the [illegible]

COMPUTER

[illegible]isty Mountains [illegible]e this game is [illegible]reat to play and is No. 1 for [illegible]and excitement '

GORDON DEMPTSTER, Scotland

"Thanks again for an excellent game in 'The Hobbit' I feel I have really got my money's worth out of playing time Congratulations!"

MR. P. RUSHTON, Leeds

"The most powerful computer game yet invented "

COMPUTER WEEKLY

"Within my circle of friends this game has become something of an obsession. We meet every Friday night at someone's house and spend 3-4 hours on 'The Hobbit'. Friday night would not be the same without 'The Hobbit' "

CHRISTINE VERCHILD, Wilts

One new Adventure game stands head and shoulders above the rest It alone almost provides you with a good enough reason to buy a 48K Sinclair Spectrum Not only does The Hobbit produce drawings of the main scenes, but it also understands proper sentences rather than pairs of words for its commands It comes with a copy of J R R. Tolkien's classic book of the same name It is the program with the most detailed and best written documentation ever."

WHAT MICRO

'This is an impressively packaged Adventure game which makes good use of the Spectrum's colour graphics They have not only produced one of the best games for the Spectrum, but given everyone else a lesson in good game design '

PRACTICAL COM[illegible]

I am the owner of a copy of The H[illegible] which is wonderful entertainment, and very challenging I have other tapes and publications of yours, all of which are excellent "

MR. D.J. BURGH, Kent

"Having received the most excellent piece of programming I have ever seen, we have had no social life whatsoever 'The Hobbit' has been dominating our lives since January and many nights have been spent until 3 o'clock trying to conquer it "

SIMON ROGERS, Avon

'I have recently purchased your excellent adventure game 'The Hobbit' This [illegible] greatly enhanced by the use of [illegible] graphics its availability in [illegible] [illegible]or having to [illegible]



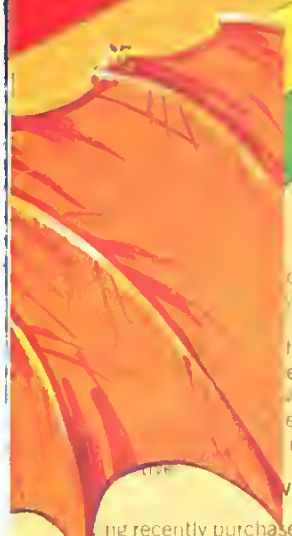
Melbourne House

than a program:

ftware library, your program 'The Hobbit' takes first place

DAVID MAXWELL, London

owner of your excellent program 'The Hobbit' and have enjoyed many happy, restful hours [illegible]



d for my ZX
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it very compelling

VEN CASSIDY, Essex

ng recently purchased a Sinclair Spectrum I decided to buy 'The Hobbit' since I have been doing a literature project based on 'The Hobbit' with my class of 10 and 11 year old children. Over the last 10 weeks the children, having read the book have been attempting the program with my assistance. Let me congratulate you on a most entertaining program."

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"... more of an experience than a program!"

POPULAR COMPUTING WEEKLY

"... the most unique factor of this program is that the user instructs the computer in completely ordinary English sentences. The Hobbit program is capable of very sophisticated communications."

ZX COMPUTING

"I purchased 'The Hobbit' not long ago and since then I have been engrossed in the game, and I'm beginning to think no-one wants to talk to me as all I talk about is my adventures in, 'The Hobbit'."

DAVID RDWLEY, Stoke-on-Trent

"The use of graphics is one of the features which makes The Hobbit special. The addition of graphics as good as these adds a whole new dimension to the Adventure. It is certainly a marvellous game, which should set the standard for future Spectrum adventures."

ZX COMPUTING

congratulate you on a [illegible] have enjoyed [illegible]ensely. I must thank you [illegible]ing such a clever product, it was worth every penny of the purchase price."

MRS. J. RYCRAFT, Northampton

"'The Hobbit' is a beautifully constructed, frantically-maddening, tortuous, gloriously inconsistent, thoroughly spooky adventure – far better than I could have hoped for and certainly the finest of the dozen or so adventure programs I have. In short, I congratulate the four who sweated for a year and a half to concoct such a super result."

MR. PETER JONES, South Glam

"Nothing is certain in this Adventure, but uncertainty! Add to this the brilliant graphics that are used to describe many of the locations and we have an Adventure that is going to become a classic for the Spectrum."

POPULAR COMPUTING WEEKLY

"I am writing to congratulate you on your excellent program 'The Hobbit' for the Spectrum. I wake up in the middle of the night with an idea and have to load the adventure to try it out."

MR. PHILLIP DARLING, Suffolk

"A most impressive package."

DAILY EXPRESS

"...we are not eating food...we are losing sleep...and it's great! I reckon you can guess why. We are lost, completely and utterly lost, in the Hobbit program."

MR. JOHN HARRIS, Kuwait

"...one of the most complex games for the Sinclair machines I have seen..."

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LIFE IS HARD at the spaceport, especially if you are the pilot of Balloon Hopper. You control a cargo hopper, a small flying transporter capable of lifting one piece of cargo at a time. The bopper is used to load the spacecraft at the top of the screen with any 10 pieces of cargo that can be found at the bottom. Each piece of cargo loaded scores either 50 or 100 points and there is a bonus of 200 points for each ship fully loaded.

Sounds easy? Unfortunately you have picked the wrong day to be the pilot because there is an air-day nearby and stray balloons keep floating in your way and hindering your job.

Each time you hit a balloon the explosion caused by the hydrogen-filled balloons weakens the hopper's force-field. You can survive four hits before your hopper can no longer function.

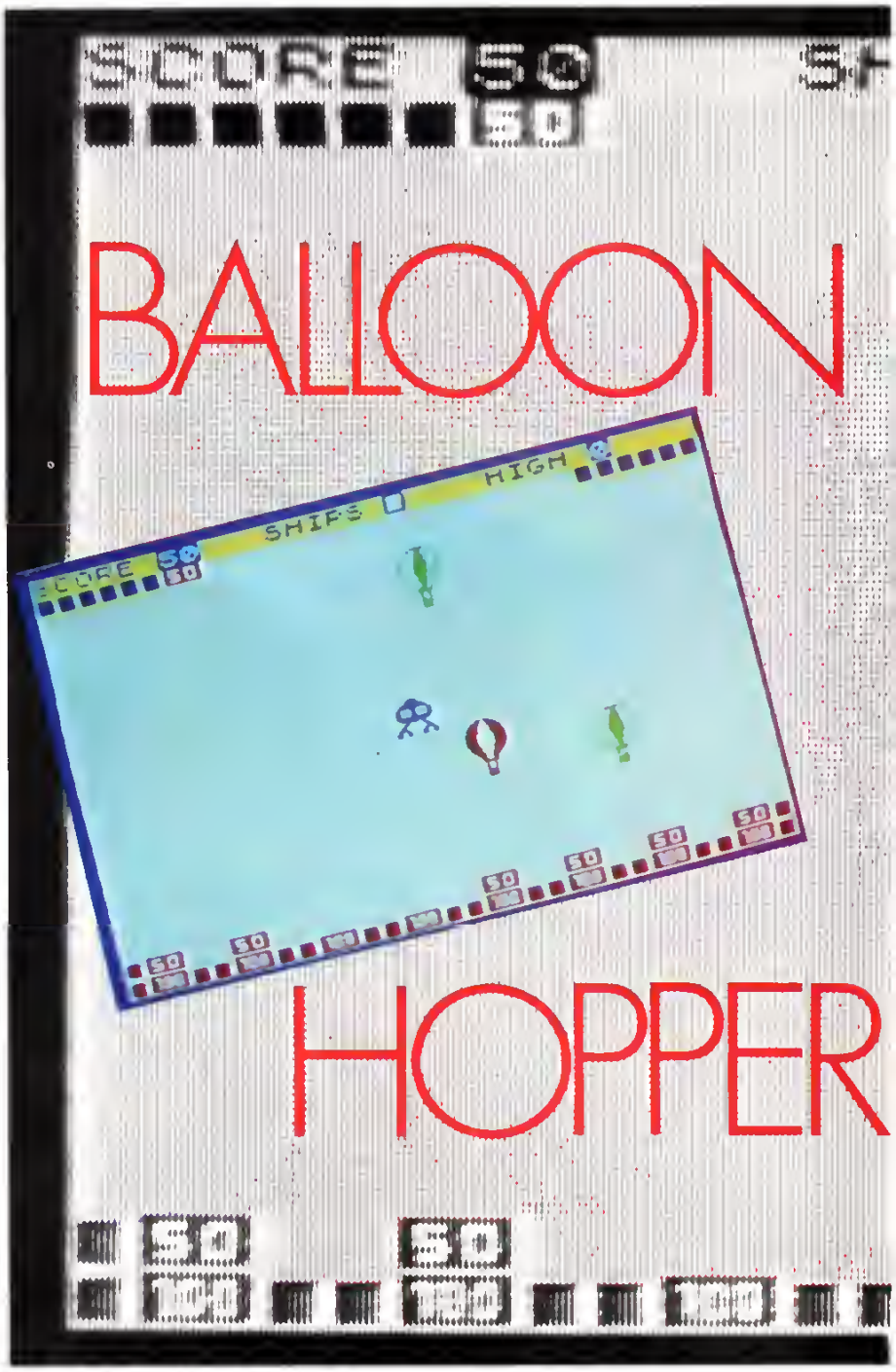
Initially there are three balloons in your way; this increases by one for each starship you load. You move using the cursor keys and you must land on top of a piece of cargo to pick it up. To drop the cargo you simply take it to the top of the screen avoiding the balloons on the way.

The program is written in Basic but contains a machine code routine which is Poked into memory from data statements when the program is first run. The machine code routine moves the balloons making the game much faster than if just using a Basic program. As the data is Poked into the memory the computer compiles a check-sum so, if you have made a typing error in the data statements, the computer should notice and warn you.

The program uses all 21 user-definable graphic characters and these are shown here. Graphics G to L do not appear in the listing because they are only used in the machine code, not the Basic part. The program is set out as follows:

5-110 Set up game
200-350 Set up screen
400-490 Main game routine
500-530 Cargo dropped
1000-1070 Life lost and end of game
2000-2090 Instructions
5000-5030 Poking in machine code and UDGs
7000-7095 UDG data
8000-8050 Machine-code data

To have more balloons at the start change Let Z=3 in line 100 to whatever you want. To have more than one extra balloon appear after a ship is fully loaded change line 527. To change the control keys change line 410. ■




```
    5 CLEAR 38999
   10 LET hs=0
   30 STRAIGHT 0  OVER 0  INVERSE 0
   FLASH 0
   40 GO SUB 5000
   50 GO SUB 2000
   90 PAPER 7  INK 1  BORDER 1: C
LS
  100 LET a=0  LET z=3
  110 LET z$="0000"
  200 LET t$="":  DIM a$(3,32)
  210 LET a$(2)="0[■][■]  [■][■]  [■][■]
  [■][■]  [■][■]  [■][■]"
  220 LET a$(3)="0[■][■][■][■][■][■][■][■]
[■][■][■][■][■][■][■][■]"
  221 CLS  LET a=32000
  225 FOR f=1 TO z
  230 POKE a,INT (RND*22+1)
  240 POKE a+1,INT (RND*13+4)
  250 POKE a+2,INT (RND*3-1)
  260 POKE a+3,INT (RND*3-1)
  270 IF NOT PEEK (a+2) AND NOT P
EEK (a+3) THEN GO TO 250
  280 POKE a+4,INT (RND*3+2)+125+
(RND>.5)
  290 POKE a+5,255
  300 LET a=a+6
  305 NEXT f
  310 PRINT AT 0,0, PAPER 5;"SCOR
E";TAB 11;"SNIPS";TAB 22;"HIGH";
TAB 0;"000000";AT 1,26;"000000"
  315 PRINT INVERSE 1;AT 0,5,a;AT
 0,17;z$;AT 0,27;hs
  320 PRINT AT 20,0; INK 2;a$(0);
a$(3)
  330 LET x=15:  LET y=2
  340 LET b$="":  LET fl=0
  350 PRINT AT 1,6; INK 2;t$
  400 LET x1=x:  LET y1=y
  410 LET x=x+(INKEY$="5")-(INKEY
$="8"):  LET y=y+(INKEY$="6")-(IN
KEY$="7")
  415 LET x=x+(x=-1)-(x=31)
  420 LET c$=a$(1+(y+fl=19)+2*(y+
fl=20),x+1 TO x+2)
  440 LET y=y+(y=1)-(y+fl=21 OR (
y+fl>19 AND c$(2)<>" "))
  450 PRINT AT y1,x1;"  ";AT y1+1
,x1;"  "
  460 IF fl=1 THEN PRINT AT y1+0,
x1;"  "
  470 PRINT AT y,x;"■";AT y+1,x;
"■";  IF fl=1 THEN PRINT AT y+2,
x;"■";INK 2;b$
  475 LET l=USR 31900
  476 IF ATTR (y,x)<>57 OR ATTR (
y+1,x)<>57 OR ATTR (y,x+1)<>57 O
R ATTR (y+1,x+1)<>57 THEN GO TO
1000
  480 IF fl=0 AND (c$(1)="■" OR c
$(1)="■") THEN BEEP .01,0:  BEEP
.1,0:  LET b$=c$:  LET fl=1:  LET a
$(y-10,x+1 TO x+2)="  "
  490 IF fl=0 OR y<>2 THEN GO TO
400
  500 LET fl=0:  PRINT AT 4,x;"  "
  505 BEEP .01,4:  BEEP .1,0:  BEEP
.01,0
  510 LET t$=t$+b$:  PRINT AT 1,5;
INK 2;t$
  515 LET s=s+50+50*(b$(1)="■"):
PRINT AT 0,5; INVERSE 0;s;
  520 IF LEN t$<20 THEN GO TO 400
  525 FOR f=1 TO 3:  FOR g=0 TO 4
  BEEP .05,g:  NEXT g:  NEXT f
  526 LET s=s+200
  527 LET z=z+1
  530 GO TO 200
1000 LET z$=z$(2 TO ):  PRINT AT
0,17; INVERSE 1;z$;  INK 0;"  "
1005 FOR f=5 TO 0 STEP -1:  FOR g
=0 TO 3:  BEEP .07,g+f:  NEXT g:  N
EXT f
1010 BEEP .1,-1:  BEEP .1,-1
1030 IF z$<>"" THEN GO TO 801
1040 BEEP 1,0:  BEEP 1,-1:  BEEP 1
,-2
1050 IF s>hs THEN LET hs=s:  PRIN
T AT 0,27; FLASH 1;hs
1060 PRINT AT 10,0; FLASH 1;"
GAME OVER  ";  INVERSE 1;"  G
AME OVER  "
```



On September 19, 1783 curious spectators, including Benjamin Franklin, watched the launch of the first passenger-carrying balloon. There were three passengers — a sheep, a duck and a rooster and the flight lasted for eight minutes. To celebrate the 200th anniversary of this aeronautical feat Andrew Foord details a simple arcade-type game for the Spectrum.

=MN
=OP
=QR
=U
=AB
=CD
=EF
=ST

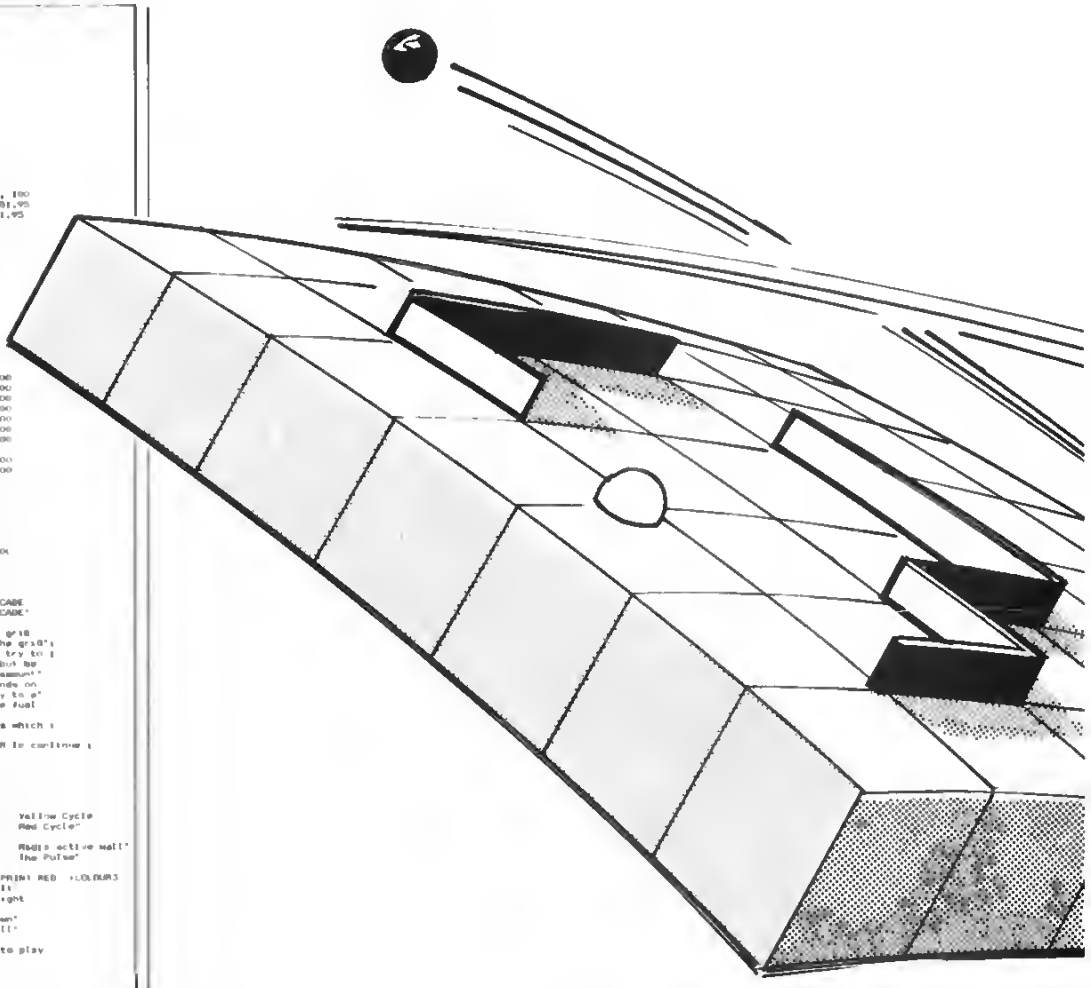
User-defined graphics.

```
1070 FOR f=1 TO 500: NEXT f: GO
TO 60
2000 BORDER 7: PAPER 7: INK 0: C
LS
2010 PRINT "This is,"'TAB 9; INK
 2;"BALLOON HOPPER"''TAB 9; INK
1;"© Andrew Foord"
2020 PRINT '" In this game you m
ust load the spacecraft at the t
op of screen with 10 pieces of c
argo from theSpaceport."
2030 PAINT " Unfortunatly it is
 air day and balloons will hinder
 you."
2040 PRINT '" Cargo
 - Cargo -    Hopper   Balloon   50
pts   100pts"
2045 PRINT AT 15,3; INK 1;"▟▙"; A
T 16,3;"▜▛"
2050 PRINT AT 15,11; INK 2;"▟▙";
AT 16,11;"▜▛"; AT 17,11;"▀"
2055 PRINT AT 15,19; INK 2;"▀▀
 ▀▀"
2060 PAINT AT 18,0,"Controls-"
2070 PAINT '" Left    Down
UP    Right"; INK 0;"      6
      7      8"
2080 PAINT #0, PAPER 0;"     Pre
ss Any Key To Play",,TAB 0
2085 IF INKEY$="" THEN GO TO 200
5
2090 RETURN
5000 PRINT AT 10,6;"PLEASE WAIT
A MOMENT"
5005 RESTORE : LET t=0: FOR f=USR
 "a" TO USR "u"+7
5010 READ a: POKE f,a: LET t=t+a
: NEXT f
5015 FOR f=01000 TO 31178: READ
a: POKE f,a: LET t=t+a: NEXT f
5020 IF t<>30025 THEN PRINT "Err
or in Data": BEEP 1,0: STOP
5030 RETURN
7000 DATA 7,30,62,124,104,000,04
0,240,224,120,124,60,62,63,31,31
7010 DATA 240,248,248,248,124,12
4,124,62
,56,14,31,31,62,62,60,120,112
7020 DATA 6,7,2,2,2,3,3,3,96,224
,64,64,64,192,192,192
7030 DATA 7,26,33,67,67,131,136,
135,224,152,132,194,194,194,193,026,
225
7040 DATA 135,135,135,67,67,36,1
7,0,025,200,225,194,194,196,136,
144
7050 DATA 5,7,0,2,2,3,3,3,100,22
4,64,64,64,192,192,192
7060 DATA 0,3,7,31,63,97,109,97,
0,192,224,240,252,134,192,134
7070 DATA 127,63,13,24,48,120,20
4,204,254,252,176,24,12,30,51,51
7080 DATA 127,97,111,97,125,97,1
27,0,254,134,182,182,182,134,254
,0
7090 DATA 127,100,117,117,117,11
0,127,0,254,70,66,66,66,70,254,0
7095 DATA 0,126,125,126,126,106,
126,0
6990 DATA 221,33,0,126,221,126,0
,254,256,40,34,95,221,86,1,6,3,5
4,22,216,122,215,123,215,62,32,2
15,62,32,215
8010 DATA 20,16,240,221,36,221,3
5,221,35,221,35,221,35,24,215,22
1,33,0,125,221,126,0,254,256,200
,221,134,2,254,256,40,4,064,31,3
0,6,201
6020 DATA 126,2,237,66,201,119,2
,221,126,1,254,2,40,4,254,17,32,
8,221,126,3,237,66,221,119,3,221
,126,0,221,134,2,221,119,0,221,1
26,1,221
6030 DATA 134,3,221,119,1,14,144
,221,203,4,126,40,10,221,203,4,1
86,62,0,129,79,24,4,221,203,4,86
4,221,126
8040 DATA 4,203,191,126,66,00,14
5,92,221,86,1,6,3,62,22,216,102,
216,221,126,0,215,121,215,12,121
,215
6050 DATA 12,20,16,236,221,36,22
1,35,221,35,221,35,221,35,195,73
,121
```

SUPER BARRIC

Program 1

```
10REM ********************
20REM **  SUPER BARRICADE  **
30REM *   By Shingo Sugiura  *
40REM **   1.2   JULY '83   **
50REM ********************
60
70PROCenv:PROC*char
80MODE7:PROCinst
90MODE1:PROCset
100VDU28,1,31,39,29
110CHAIN"MAIN
120
130DEFPROCenv
140ENVELOPE1 1,0,0,0,0,0,0  1,1,1,1,126,100
150ENVELOPE2,1,%  %%,%% 6 10  1,1,1  1 81,95
160ENVELOPE3 1,6  19,4,5 3 8 120 63 0  3 81,95
170ENDPROC
180
190DEFPROCchars
200VDU23,218,130,130,130,254,226,226,226,0
210VDU23,219,128,128,128,224,224,224,254,0
220VDU23,220,136,136,136,254,226,226,226,0
230VDU23,221,138,138,138,234,234,234,254,0
240VDU23,222,254,138,138,248,224,224,224,0
250VDU23,224,0,60,0,153,153,0,60,24
260VDU23,225,0,0,120,255,255,120,0,0
270VDU23,226,0,0,30,255,255,30,0,0
280VDU23,227,24,60,60,60,60,24,24,24
290VDU3,228,24,24,24,60,60,60,60,24
300VDU23,229,24,24,24,255,255,24,24,24
310VDU23,230,36,36,255,36,36,255,36,36
320VDU23,231,&00,&00,&FE,&FE,&FE,&FE,&FE,&00
330VDU23,232,&FE,&80,&80,&FE,&FE,&0E,&FE,&00
340VDU23,233,&FE,&80,&80,&F0,&F0,&E0,&FE,&00
350VDU23,234,&FE,&E4,&E4,&FE,&E2,&E2,&E2,&00
360VDU23,235,&FE,&E0,&E0,&FE,&E0,&E0,&FE,&00
370VDU23,236,&FE,&EA,&EA,&EA,&EA,&E2,&E2,&00
380VDU23,237,&7C,&44,&44,&FE,&E2,&E2,&E2,&00
390VDU23,238,254,32,32,54,54,54,54,0
400VDU23,239,&FE,&E2,&E2,&E2,&E2,&E2,&FE,&00
410VDU23,240,&38,&00,&00,&38,&38,&38,&38,&00
420VDU23,241,130,130,254,40,40,56,56,0
430VDU23,242,252,128,130,224,230,228,252,0
440VDU23,243,254,130,130,130,228,228,228,0
450VDU23,244,252,132,132,254,228,228,254,0
460VDU23,245,254,130,254,130,228,224,224,0
470VDU23,246,130,130,130,224,228,228,254,0
480VDU23,247,252,130,130,228,228,228,252,0
490VDU23,248,&FE,&E2,&E2,&FE,&0E,&0E,&FE,&00
500VDU23,249,136,136,136,228,228,228,124,0
510ENDPROC
520
530DEFPROCinst
540PRINTCHR$134;CHR$141;TAB(12;"SUPER BARRICADE"
550PRINTCHR$134;CHR$141;TAB(12;"SUPER BARRICADE"
560PRINT TAB(10;CHR$133;"By Shingo Sugiura"
570PRINT''"Control your cycles around the grid"
580PRINT"avoiding the walls or going off the grid";
590PRINT"Release your radio active tail to try to l
600PRINT"force your opponent off the grid but be
610PRINT"cautious as this uses up a large amount"'
620PRINT"of energy on which your life depends on.
630PRINT"You can replenish your fuel supply to g"
640PRINT"certain degree By driving over the fuel
650PRINT"pods littered around the grid."
660PRINT"Of course watch out for the pulses which
670PRINT"inhabit the grid."
680PRINT CHR$136CHR$131"    Press SPACE BAR to continue
690REPEATUNTILGET=32
700ENDPROC
710
720DEFPROCcol:VDU19,3,&101/.2
730PRINTTAB(13;"SUPER BARRICADE"
740COLOUR1:PRINT TAB(2;"By Shingo Sugiura
750COLOUR2:PRINT CHR$227;:COLOUR3:PRINT"      Yellow Cycle
760COLOUR1:PRINT CHR$227;:COLOUR3:PRINT"      Red Cycle"
770PRINT CHR$234"          Fuel pod"
780COLOUR1:PRINT CHR$230;:COLOUR3:PRINT"      Radio active wall"
790COLOUR1:PRINT CHR$224;:COLOUR3:PRINT"      The Pulse"
800PRINT''"Controls:-"
810COLOUR2:PRINT"YELLOW TAB(20);:COLOUR1:PRINT"RED":COLOUR3
820PRINT" Q      Up" TAB(20)"      Left
830PRINT" N      Right TAB(20)"      Right
840PRINT" A      Up"TAB(20)"  C RIGHT  Up"
850PRINT" B      Down"TAB(20)"  C UP    Down"
860PRINT" Z      Wall"TAB(20)" BEL     Wall"
870COLOUR1:PRINT''"Or use joysticks."
880COLOUR3:PRINT"          Press SPACE BAR to play
890REPEATUNTILGET=32
900ENDPROC
```



FIRST THE good news. This game is original, fast, and has good graphics and sound. Now the bad news. It only works with O.S. 1.2, is hyper-long, and needs a second player

The game involves two cycles — no, it is not Tron — on the electric grid. The grid is inhabited by creatures called Pulses and you must avoid these at all costs. At the beginning of each grid each player starts with 300 units of energy. This decreases with each move but there are fuel pods littered around the grid so that energy can be replenished. Each player can also release radio-active walls to gain bonus but this eats up energy and, of course, if you run out of energy you will be vapourised

Each grid has a time limit and if both players are alive at the end of the time limit they will go onto a harder grid. If they are still alive at the end of five grids they will go onto the Death Grid to battle it out to the end. In this grid, each player will get 100 units of energy on top of the bonus earned in the previous grids. The radio-active tail is released automatically and continuously so the battle is unlikely to last for more than a few seconds.

The game can be played with keyboard as well as joysticks — ANH01 type is suitable

Type in the first program then Save it under a name other than Main Then type in the second program and Save this under the name Main If you have the disc system simply type it in but do not run it Save before running. When you want to play the game run the first program and this will reset page and allow the program to run but do not press Break as this will corrupt the program and Old will not bring the program back. Also with the disc system you must make the following adjustments:

```
110 *KEY0PAGE=&1100 MCHAIN"MAIN"
    M
120 *FX138,0,128
```

As I said earlier, this program will not work with OS before 1.2 but it is possible to convert the program to run on OS 0.1 if you put a lot of effort into it Anyway the OS 1.2 is now readily available in shops so there is no excuse for hanging on to your bug-filled OS 0.1

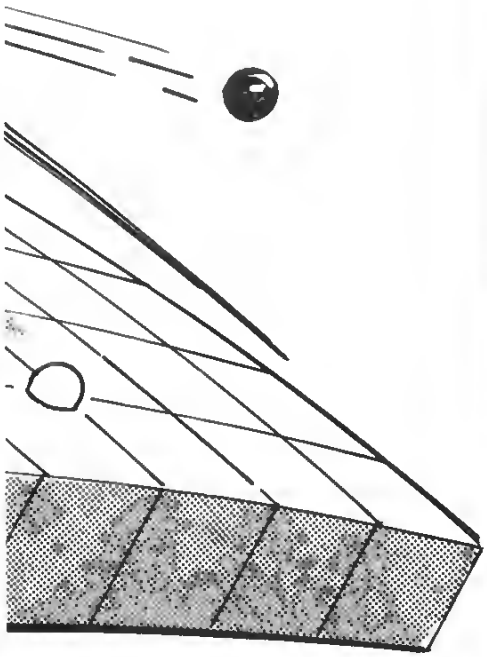
If you want to play the game but do not want to type in such a long program send a postal order or a cheque made payable to Shingo Sugiura for £3 to 42 Landford Road, Putney, London, SW15 1AG

The game consists of two programs. The first program sets up the envelopes and defines the characters and prints the instructions The second program is the game itself

Line 10 . Selects mode 1 and asks players if they went joystick control or keyboard control
Line 20 . . . Calls procedure to assemble short machine-code routine
Line 30 Let grid equel 1.

CADE

Watch out for the deadly pulses which inhabit the grid of this two-player game by Shingo Sugiura for the BBC Micro. The game can be played with keyboard or joysticks.



Program 2.

```
  5 REM FOR £ READ HASH CHARACTER
 10MODE1:PROCoption
 20PROCass
 30grid=1
 40wall1%=0:wall2%=0
 50MODE1
 60PROCinit
 70PROCgrid
 80FORA=100TO130:SOUND&01,2,A,1:NEXT
 90TIME=0
100REPEAT
110IF A$="2" PROCkeye1:PROCkeye2
120IF A$="1" PROCjoy1:PROCjoy2
130but%=ADVAL(0)AND3
140PROCcheck1:PROCcheck2
150PROCcontrol1:PROCcontrol2
160VDU17,3,31,6,30:PRINT;2000-TIME;"  ";
170IF TIME>=2000 THEN time=0
180UNTIL flag1=0 OR flag2=0 OR time=0
190IF time=0 AND grid>4 PROCdeathgrid:GOTO230
200IF time=0 AND grid<=4 PROCnewgrid:GOTO50
210PROCexplode
220PROCnewgame
230GOTO30
240
250DEFPROCinit
260time=TRUE
270flag1=TRUE:flag2=TRUE
280X1=10:Y1=25
290X2=29:Y2=25
300x1inc=0:y1inc=-1
310x2inc=0:y2inc=-1
320energy1%=300:energy2%=300
330VDU23;10,32;0;0;0;
340ENDPROC
350
360DEFPROCkeye1
370IF INKEY(-17) x1inc=-1:y1inc=0:ENDPROC
380IF INKEY(-34) x1inc=1:y1inc=0:ENDPROC
390IF INKEY(-52) x1inc=0:y1inc=-1:ENDPROC
400IF INKEY(-51) x1inc=0:y1inc=1:ENDPROC
410ENDPROC
420
430DEFPROCjoy1
440A1%=ADVAL(1):A2%=ADVAL(2)
450IF A1%>=52000 x1inc=-1:y1inc=0:ENDPROC
460IF A1%<=12000 x1inc=1:y1inc=0:ENDPROC
470IF A2%>=52000 x1inc=0:y1inc=-1:ENDPROC
480IF A2%<=12000 x1inc=0:y1inc=1:ENDPROC
490ENDPROC
500
510DEFPROCkeye2
520IF INKEY(-73) x2inc=-1:y2inc=0:ENDPROC
530IF INKEY(-89) x2inc=1:y2inc=0:ENDPROC
540IF INKEY(-122) x2inc=0:y2inc=-1:ENDPROC
550IF INKEY(-58) x2inc=0:y2inc=1:ENDPROC
560ENDPROC
570
580DEFPROCjoy2
590B1%=ADVAL(3):B2%=ADVAL(4)
600IF B1%>=52000 x2inc=-1:y2inc=0:ENDPROC
610IF B1%<=12000 x2inc=1:y2inc=0:ENDPROC
620IF B2%>=52000 x2inc=0:y2inc=-1:ENDPROC
630IF B2%<=12000 x2inc=0:y2inc=1:ENDPROC
640ENDPROC
650
660DEFPROCgrid:VDU19,3,6;0,0;COLOUR3
670FOR I=3 TO 25:VDU31,1,I
680PRINTSTRING$(38,CHR$229):NEXT
690FORA=1TO10:PRINTTAB(RND(36)+2,RND(20)+5)CHR$231:NEXT
700VDU17,1,31,13,1,232,246,245,235,234,32,32
710VDU244,237,234,234,240,233,237,247,235
720VDU17,2,31,1,27,235,243,235,234,242,241,58:PRINT;energy1%
730VDU31,1,28,244,239,243,246,232,58:PRINT;wall1%
740VDU17,1,31,20,27,235,243,235,234,242,241,58:PRINT;energy2%
750VDU31,20,28,244,239,243,246,232,58:PRINT;wall2%
760VDU17,3,31,1,30,238,240,236,235,58:PRINT"2000"
770VDU31,20,30,242,234,240,247,32,grid+48
780PROCpulse
790VDU17,2,31,X1,Y1,227,17,1,31,X2,Y2,227
800ENDPROC
810
820DEFPROCpulse:COLOUR1
830FOR pul=1 TO grid*7+RND(grid*3)
840PRINTTAB(RND(36)+2,RND(20)+5)CHR$224
850NEXT
860VDU17,3,31,X1,Y1-1,229,31,X2,Y2-1,229
870ENDPROC
880
890DEFPROCcontrol1
9001FINKEY(-98) OR but%=1 OR but%=3 VDU17,2,31,X1,Y1,230:wall1%=wall1%+3:energ
y1%=energy1%-3:ELSE VDU17,3,31,X1,Y1,229
910VDU17,2:Y1=Y1+y1inc:X1=X1+x1inc
920VDU31,X1,Y1
9301Fx1inc=1 VDU226 ELSE1F x1inc=-1 VDU225 ELSE 1F y1inc=1 VDU228 ELSE VDU227
940energy1%=energy1%-1:PRINTTAB(8,27);energy1%;"  "
950PRINTTAB(7,28);wall1%;
9601F energy1%<=0 flag1=0
970ENDPROC
980
990DEFPROCcontrol2
10001FINKEY(-90) OR but%=2 OR but%=3 VDU17,1,31,X2,Y2,230:wall2%=wall2%+3:energ
y2%=energy2%-3:ELSEVDU17,3,31,X2,Y2,229
1010VDU17,1:Y2=Y2+y2inc:X2=X2+x2inc
1020VDU31,X2,Y2
10301Fx2inc=1 VDU226 ELSE1F x2inc=-1 VDU225 ELSE 1F y2inc=1 VDU228 ELSE VDU227
1040energy2%=energy2%-1:PRINTTAB(27,27);energy2%;"  "
105DPRINTTAB(26,28);wall2%;
10601F energy2%<=0 flag2=0
1070ENDPROC
1080
1090DEFPROCcheck1
1100VDU31,X1+x1inc,Y1+y1inc:CALL code
11101F ?&70=133 ENDPROC
11201F ?&70<>135 flag1=0:ENDPROC
1130SOUND&02,2,100,5:energy1%=energy1%+10
1140ENDPROC
```

(listing continued on next page)

Line 60 . . . Calls procedure to initialise variables
Line 70 . . Calls procedure to print the grid.
Line 80 Sound at start of each grid
Line 90 . Reset time
Lines 100 to 230 . Main program.
Lines 250 to 340 . Procedure to initialise variables
Lines 360 to 410 . . . Checks keys for yellow cycle
Lines 430 to 490 . . . Checks joystick1.
Lines 510 to 560 . . Checks keys for red cycle.
Lines 580 to 640 . . Checks joystick2.
Lines 660 to 870 . . Sets up the screen
Lines 820 to 870 . . . Prints an appropriate number of pulses
Lines 890 to 970 . . . Prints out the yellow cycle and also decides whether the tail should be printed.
Lines 980 to 1070 . Prints the red cycle and also the tail if it should be.
Lines 1090 to 1140 . Checks the next position of the yellow cycle.
Lines 1160 to 1210 . . Checks the next position of the red cycle.
Lines 1230 to 1300 . . The procedure called at the end of each grid.
Lines 1320 to 1340 . Explosion.
Lines 1360 to 1460 . Prints out the winner.
Lines 1480 to 1580 . Main routine for the death grid
Lines 1600 to 1690 . . Prepares players for the death grid.
Lines 1710 to 1760 . Sets up variables necessary for the death grid.
Lines 1780 to 1850 . . Sets up the screen.
Lines 1870 to 1960 . . Prints out the yellow cycle.
Lines 1980 to 2070 . . Prints out the red cycle.
Lines 2090 to 2110 . . Death routine for the death grid.
Lines 2120 to 2290 . Procedure to ask players if they would like joystick control or keyboard control
Lines 2310 to 2380 . . Assemble a short machine code routine to find the character at the present cursor position.

(listing continued from previous page)

```
1150
1160DEFPROCcheck2
1170VDU31,X2+x2inc,Y2+y2inc:CALL code
1180IF ?&70=17 ENDPROC
1190IF ?&70= 145 flag2=0:ENDPROC
1200SOUND&01,2,0,5:energy2%=energy2%+1
1210ENDPROC
1220
1230DEFPROCnewgrid:PRINTTAB(6,30)a "
1240FOR A=0TO80:SOUND&01,5,A,1
1250NEXT
1260grid=grid+1
1270VDU12,17,3,"1,10,10,232,246,234,249,240,240,235,247,32
1280VDU242,234,24+,247,32,grid+47
1290FOR A=1 TO 400:NEXT
1300ENDPROC
1310
1320DEFPROCexplode
1330SOUND0,1,100,5
1340ENDPROC
1350
1360DEFPROCnewgame:FOR A=1 TO 3000:NEXT:CLS:*FX15,0
1370VDU31,8,6,238,236,246,242,218,32,219,246,233,220,32
1380IF flag1=0 VDU241,235,219,218,230,221,32,233,241,233,218,235 ELSE VDU234,23
5,247,32,233,241,233,218,235
1390VDU31,8,12
1400IF flag1=0 VDU254,235,247,32,233,241,233,218,235,32 ELSE VDU241,235,219,218
,239,221,32,233,241,233,218,235,32
1410VDU241,239,246,32,221,240,243
1420VDU31,10,15,241,230,246,32,242,239,230,32
1430VDU238,239,32,242,234,240,247,32,grid+48
1440PRINTTAB(6,20)"Press "1
1450VDU232,245,237,233,235,32,244,237,234,32:PRINT"to play"
1460REPEATUNTILGET=32:ENDPROC
1470
1480DEFPROCdeathgrid:PROCinfo
1490PROCinit2
1500PROCfingrid
1510FORA=100TO200:SOUND&01,2,A,1:NEXTA
1520REPEAT
1530PROCkeyel:PROCkeye2
1540PROCcycle1:PROCcycle2
1550UNTIL flag1=0 OR flag2=0
1560PROCdie
1570PROCnewgame
1580ENDPROC
1590
1600DEFPROCinfo
1610PRINTTAB(6,30)"0  "
1620FOR A=0TO100:SOUND&01,3,A,1
1630NEXT
1640VDU12,17,3,31,10,10,232,246,234,249,240,249,235,247
1650VDU32,202,234,240,247,32,grid+48
1660VDU17,2,31,7,20,245,234,235,245,237,234,235,32,222,239,234,32
1670VDU247,235,237,238,218,32,242,234,240,247
1680FOR A=1 TO 4000:NEXT
1690ENDPROC
1700
1710DEFPROCinit2
1720flag1=TRUE:flag2=TAUE
1730X1=10:Y1=25:X2=29:Y2=25
1740x1inc=0:y1inc=-1:x2inc=0:y2inc=-1
1750energy1%=100+wall1%:energy2%=100+wall2%
1760ENDPROC
1770
1780DEFPROCfingrid:VDU12,19,3,5;0;17,3
1790FOR I=3 TO 25:VDU31,I,I
1800PRINT@TRING@138,CHR@229:NEXT
1810VDU17,1,31,13,1,247,235,237,238,218,32,242,234,240,247
1820VDU17,2,31,1,27,235,243,235,234,242,241,58:PRINT;energy1%
1830VDU17,1,31,20,27,235,243,235,234,242,241,58:PRINT;energy2%
1840VDU17,2,31,X1,Y1,227,17,1,31,X2,Y2,227
1850ENDPROC
1860
1870DEFPROCcycle1
1880VDU31,X1+x1inc,Y1+y1inc:CALL code
1890IF ?&70<>133:flag1=0:ENDPROC
1900VDU17,2,31,X1,Y1,230
1910X1=X1+x1inc:Y1=Y1+y1inc
1920VDU31,X1,Y1
1930IFx1inc=1 VDU224 ELSEIF x1inc=-1 VDU225 ELSEIF y1inc=1 VDU228 ELSE VDU227
1940energy1%=energy1%-1:PRINTTAB(8,27);energy1%;"  "
1950IF energy1%<=0 flag1=0
1960ENDPROC
1970
1980DEFPROCcycle2
1990VDU31,X2+x2inc,Y2+y2inc:CALL code
2000IF ?&70<>133 flag2=0:ENDPROC
2010VDU17,1,31,X2,Y2,230
2020X2=X2+x2inc:Y2=Y2+y2inc
2030VDU31,X2,Y2
2040IFx2inc=1 VDU224 ELSEIF x2inc=-1 VDU225 ELSEIF y2inc=1 VDU228 ELSE VDU227
2050energy2%=energy2%-1:PRINTTAB(27,27);energy2%;"  "
2060IF energy2%<=0 flag2=0
2070ENDPROC
2080
2090DEFPROCdie:SOUND0,1,100,5
2100FORA=25STO100STEP-1:SOUND&01,3,A,1:NEXT
2110ENDPROC
2120DEFPROCoption
2130VDU17,1,31,13,1,232,246,245,235,234,32,32
2140VDU244,237,234,234,240,233,237,247,235,17,2
2150PRINT   TAB(12)"By Shingo Sugiura":COLOUR3
2160PRINT  "  You have the option of using the"
2170PRINT"keyboard or the ANHOI joysticks to"
2180PRINT"control your cycles."
2190PRINT  "If using joysticks, yellow cycle is"
2200PRINT"controlled by joystick1 and the red"
2210PRINT"cycle is controlled by joystick2.":COLOUR2
2220PRINT  "1 -Joystick control"
2230PRINT "2 -keyboard control"
2240COLOUR1:PRINT  "Which option? "1
2250REPEAT:A$=INKEY$(10):UNTIL A$="1" OR A$="2"
2260PRINT;A$:COLOUR3
2270PRINT      Press SPACE BAR to enter grid";
2280REPEAT UNTIL GET=32
2290ENDPROC
2300
2310DEFPROCsave:OSBYTE=&FFF4
2320DIM code 10
2330OPT=code
2340IOPT 0
2350LDAC135:JSR OSBYTE
2360STX&70
2370RTS:1
2380ENDPROC
```


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A bug tracer on your Spectrum can save time and end frustration. Gary Rees explains how to add this feature.



"But how did you deduce that there was a bug in line 400, Holmes?"

DEBUGGING YOUR PROGRAMS

Listing 1.

```
0001      (C) GARRY AEES 1983.
          MEMORY LEFT,TAACE AND SPEED ROUTINES.
5         FE69            ORG  65129
69        00              NOP
70        00              NOP
71        FF              RST  38H
85        F3        L5:   DI
DISABLE  FURTHER  INTEARUPTS
90        C5              PUSH BC
110       D5              PUSH DE
130       E5              PUSH HL
150       F5              PUSH AF
STACK REGISTER VALUES FOR RETURN
170       01FEBE          LD   BC,49150
INITIALISE 'BC' READY FOR KEYBOARD AEAD
190       ED78            IN   A,(C)
READ KEYBOARD
210       FEFC            CP   0FCH
IS 'ENTER' AND 'L' BEING PRESSED?
230       281C            JR   Z,L2
IF YES THEN GOTO L2
235       FEFA            CP   0FAH
IS 'ENTEA' AND 'K' BEING PRESSED?
237       280A            JA   Z,ON
238       FEF6            CP   0F6H
239       200B            JR   NZ,TEST
IF 'ENTER' AND 'J' IS BEING PRESSED THEN
 SWITCH TRACE FLAG OFF
243       AF              XOR  A
ZERO THE ACCUMULATOR
245       3290FE          LD   (FLAG),A
250       1805            JA   TEST
255       3E01      ON:   LD   A,1
260       3290FE          LD   (FLAG),A
SWITCH 'TAACE' FLAG ON
265       CD85FE    TEST: CALL L3
CALL THE MAIN ROUTINE
270       F1        UNSTK: POP  AF
290       E1               POP  HL
310       D1               POP  DE
320       C1               POP  BC
RESTORE ORIGINAL REGISTER VALUES.
```

(listing continued on page 85)

USING MACHINE CODE you can add some useful features to your Spectrum but there is often the disadvantage that the routines may have to be called many times using commands like Randomise and USR. One way of overcoming this problem is to use interrupts to call your code automatically.

If you want to use more than one routine, however, there is the problem of switching between routines, that is turning each one off and on as and when desired. This problem can be overcome by using a combination of key presses to switch routines without having to stop any Basic program that may also be running.

I use the Enter key as an extra Shift key. It still works as normal but if it is held down and another key is pressed this will signal the routine which utility I want turned on. I decided to use interrupts to give my Spectrum some of the features found on other computers.

(continued on page 85)

AGF

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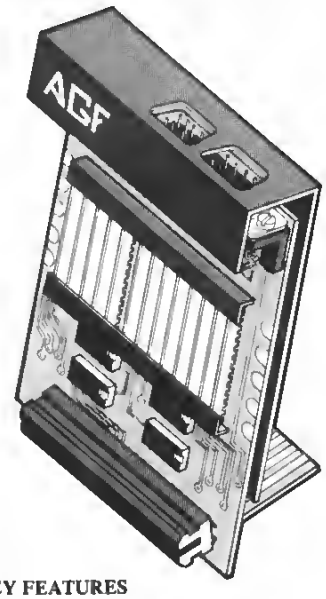
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(listing continued from page 83)

```
350       FB              EI
RE-ENABLE FOR NEXT INTERRUPT.
370       C9              RET
390       CDAAFE    L2:   CALL  STOP
400       18F5            JR    UNSTK
SWITCH ROUTINE OFF FROM KEYBOARD.
560       00              NOP
570       00              NOP
610       00              NOP
620       00              NOP
670       3E09            LD    A,9
690       ED47            LD    I,A
710       ED5E            IM2
730       C9              RET
DIVERT INTERRUPTS TO MY ROUTINE.
750       00              NOP
760       00              NOP
770       00              NOP
800       3E3E      STOP: LD    A,03EH
810       ED47            LD    I,A
820       ED56            IM1
830       C9              RET
RESTORE INTERRUPT VECTOR REGISTER TO NORMAL.
START OF MAIN ROUTINE.
840       00              NOP
850       00              NOP
860               FLAG:   DEFB  00H
990               SCN:    DEFW  20671
ADDRESS OF DISPLAY IN DISPLAY FILE.
1030      ED5B655C  L3:   LD    DE,(23653)
1035      218F50          LD    HL,20671
1036      22B3FE          LD    (SCN),HL
RESTORE DISPLAY FILE ADDRESS.
1038      3A9DFE          LD    A,(FLAG)
1039      FE01            CP    1
1040      CC25FF          CALL  Z,DEL
IF 'TRACE' FLAG ON THEN CALL 'TRACE' AND 'SPEED'.
1042      2005            JR    NZ,L14
OTHERWISE CALL 'MEMORY LEFT' ROUTINE.
1044      2A455C          LD    HL,(23621)
1046      1805            JR    L13
1048      C0051F    L14:  LD    HL,(23730)
1056      ED52            SBC   HL,DE
FIND OUT HOW MUCH MEMORY IS LEFT.
1060      01F0D8    L13:  LD    BC,-10000
1070      CDF5FE          CALL  SR2
HOW MANY 'TEN THOUSANDS' OF BYTES ARE THERE?
1100      0118FC          LD    BC,-1000
1103      CDF2FE          CALL  SR2
HOW MANY 'THOUSANDS' OF BYTES ARE THERE?
1105      019CFF          LD    BC,-100
1107      CDF2FE          CALL  SR2
HOW MANY 'HUNDREDS' ARE THERE?
1108      01F6FF          LD    BC,-10
1109      CDF2FE          CALL  SR2
1110      01FFFF          LD    BC,-1
1111      CDF2FE          CALL  SR2
HOW MANY 'TENS' AND 'ONES' ARE THERE?
1113      C9              RET
1115      AF        SR2:  XOR   A
1117      09        LA1:  ADD   HL,BC
1125      3C              INC   A
1130      38FC            JR    C,LA1
1135      ED42            SBC   HL,BC
1150      3D              DEC   A
THE ABOVE ROUTINE CALCULATES EACH DIGIT
1170      C630            ADD   A,30H
AND CONVERTS IT TO ASCII
1172      E5              PUSH  HL
1175      CD0CFF          CALL  SR
1177      2183FE          LD    HL,SCN
1179      34              INC   (HL)
INCREASE SCREEN ADDRESS READY FOR NEXT DIGIT
1181      2AB3FE          LD    HL,(SCN)
1183      CD19FF          CALL  L7
1185      E1              POP   HL
1190      C9              RET
1233      ED4B365C  SR:   LD    BC,(23606)
1250      2600            LD    H,0
1270      6F              LD    L,A
1290      29              ADD   HL,HL
1300      29              ADD   HL,HL
1310      29              ADD   HL,HL
1330      09              ADD   HL,BC
1340      EB              EX    DE,HL
1350      C9              RET
THE ABOVE ROUTINE FINDS THE ADDRESS OF THE CHARACTER IMAGE IN THE CHARACTER TABLE
1400      0608      L7:   LD    B,8
1410      1A        L8:   LD    A,(DE)
1440      77              LD    (HL),A
1460      24              INC   H
1480      13              INC   DE
1500      10FA            DJNZ  L8
1520      C9              RET
THIS WILL 'PRINT' A DIGIT ON THE SCREEN
1600      060A      DEL:  LD    B,10
1620      C5        D2:   PUSH  BC
1630      01F401          LD    BC,500
1650      210000          LD    HL,0000
1660      110000          LD    DE,0000
1680      EDB0            LDIR
1700      C1              POP   BC
1710      10F1            DJNZ  D2
1720      C9              RET
SPEED ROUTINE TO DELAY RETURN
9999                      END
```

(continued from page 83)

The first of these is a constant display of how much memory is left, whether you are running a Basic program or just entering a line of Basic.

The current position of RAMtop is of course taken into account and if you are entering a line the free memory can be seen to decrease as each keyword or character is typed. When running a program the free memory decreases as each variable is assigned.

The second feature I decided to add is Trace. This displays the number of the line currently being executed by Basic and is useful for debugging programs and following the program flow.

A slight problem arises here though. The lines of Basic are read and interpreted so quickly that following the program flow becomes difficult for us humans. For this reason I have added a third feature, Speed. This simulates slowing the processor down to one of 256 different speeds and, as well as being useful in this application, can also be used to vary the speed of games to suit personal taste. Note, however, that listings and keyboard reads are slowed.

The speed may be varied by Poking location 65315, on the 48K version, with a number between 1 and 255. A value of 1 slows program execution down only slightly and will be hardly noticeable, a value of 255 is very very slow and should be used with caution as the keyboard is then read only every few minutes and keys will have to be held down until they are read. Poking with zero has a similar effect to Poking with 255.

The program itself starts at 65129 but is switched on initially by entering Randomise USR 65183. This turns on the Memory Left routine. If Enter is held down and K is pressed then Trace and Speed are switched on. This will display 65534 until it is actually used. If Enter and J are pressed then Speed and Trace are off and Memory Left is on.

The program can be turned off completely by holding down Enter and pressing L or by entering Randomise USR 65193.

Switching on changes the interrupt vector register to point to the machine-code program and the program is then called up to 50 times a second depending upon the value of Speed. The value of Memory Left or Current Line Number is displayed on line 23 of the screen just above the normal K cursor position but this can be changed to any part of the screen if you prefer by Poking locations 65210 and 65211 with the display file address you want. For example, to change the display to 16384 — line 0, column 0:

Poke 65211, INT(18384/256).
Poke 65210, 16364 – 256*INT(16364/255)

Interrupts are disabled during Loading and Saving and so the machine-code program will stop temporarily but will recommence when the Load etc, is complete.

The program was written for a 48K Spectrum using an assembler and is stored above RAMtop to prevent it being overwritten by Basic variables. If you have an assembler then simply enter listing 1, Save the object code on tape, type Clear 65128 and re-load the code. On typing Randomise USR 65183 the free memory should appear on line 23. If it does not then check your assembler listing carefully.

For those using 16K and an assembler the following changes have to be made:

Line 5 becomes	ORG 32346
Line 670 becomes	LD A,40

If you do not have an assembler enter the appropriate Basic listing. Remember to Save the machine code on tape before switching the routine on, just in case you make a mistake when entering the data.

The 16K version is switched on by typing Randomise USR 32402. The Speed adjuster is at location 32534 and the display position can be altered by Poking locations 32429 and 32430.

Save the 16K version with

SAVE "MEM"CODE 32384,203

or the 48K with

SAVE "MEM"CODE 65129,203 ■

Listing 2.

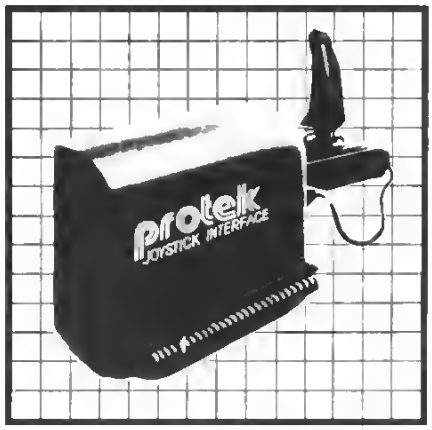
```
 0  REM (c)GARRY REES 1983
 1  REM 16K VERSION
10   CLEAR 32347
20   FOR F= 32346 TO 32506
30   READ N.POKE F,N
40   NEXT F
50   STOP
110   DATA  5,6,200,543,167,213,2
30,245,1,204
120   DATA  151,237,176,204,255,4
8,6D,204,255,46
130   DATA  10,254,24D,32,11,175,
50,186,186,64
140   DATA  5,56,1,56,1D6,152,686
,1D6,15D,241
150   DATA  526,255,193,251,201,2
56,15D,15D,24,245
160   DATA  5,5,5,5,D5,40,237,71,
637,94
170   DATA  621,5,5,5,62,62,637,7
1,637,D5
180   DATA  221,5,2,5,151,56,657,
91,151,62
190   DATA  33,121,56,34,186,125,
56,186,186,554
200   DATA  1,504,21,127,32,5,42,
50,92,54
210   DATA  5,42,178,92,237,62,1,
240,215,505
220   DATA  229,126,1,54,252,205,
220,126,1,186
530   DATA  550,205,225,186,1,54D
,205,505,255,186
240   DATA  1,255,25D,505,226,186
,201,17D,2,50
550   DATA  5D,556,237,56,61,186,
4D,222,556,255
560   DATA  15D,33,1D6,186,52,42,
186,12D,25D,12
270   DATA  157,55D,561,537,7D,54
,55,36,5,111
280   DATA  41,41,41,5,535,561,5,
D,2D,119
290   DATA  35,19,19,560,561,5,19
,157,1,244
300   DATA  1,33,5,5,17,5,5,237,1
7D,163
310   DATA  19,241,251
```

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Palon	Flight Simulation VU 3D
Protek	Airliner Spectrapede Venture Roadrunner
Rabbit	Escape MCP Quackers Race Fun Centropods
Silvereoft	Ground Attack Cyber Rats
Sunshine	Android
Ultimate	Cookie
Romax	Colour Clash

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Leap out of trouble with Brian Lewis's Frogger.

THIS GAME IS WRITTEN for the 48K Oric although I see no reason why it should not be run on the 16K machine.

The game follows the normal Frogger scenario. You, the frog, have to work your way up the screen. First, you must dodge oncoming cars and lorries, then you have to jump on the passing logs in the upper part of the display. To move forward press A, to move left press N and to go right press M. Once you resch the top row you must jump into one of the five froggy homes. Once all five homes are filled you progress to the next sheet. Getting hit by a car or lorry, missing a log, or home will result in one of your three lives being lost.

The colours in the program can be changed by listing lines 20 to 30, and changing the escape characters. The main display may also be altered by listing lines 1000 to 1010. If the user-defined graphics are not to your liking then these are contained between lines 1010 and 2000. The sub-routines 6000 and 7000 check for loss of life and arrival at a home. Lines 80 to 90 keep the logs and vehicles scrolling smoothly and should not be tampered with. Scoring is as follows: 10 points for every jump forward; 100 points for every screen completed.

If the game becomes too easy then reduce the For-Next loop in line 50 or take out either left or right movement.

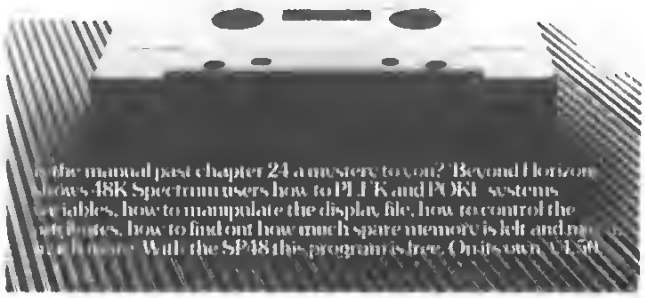
The small machine-code sub-routine at the beginning of the program is necessary because of the method of scrolling the logs and vehicles. It was borrowed from the chapter on machine code in the Oric manual.

```
0 LIVES=3:REM FOR £ READ HASH CHARACTER
1 CLS
2 REPEAT
3 READD
4 POKE£400+C,D
5 C=C+1:UNTIL D=£FF
6 DATA£20,£96,£D9,£AC,£F8,£02,£C8,£8C,£69,£02,£A5,£1F,
£A4,£20,£85,£[2,£84,£13
7 DATA£A9,£3B,£20,£DB,£CF,£4C,£61,£C8,£FF
8 DOKE£2F5,£400
9 GOSUB1000
11 A$(1)="o[[[[p                    o[[[[p
o[[[[p
     "
12 A$(2)="u[[i          u[[i          u[[i          u[
i          u
[[i       "
13 A$(3)="   o[[[p                 o[[[p                 o
[[[p
    "
14 A$(4)="u[[[[i             u[[[[i             u[[[[i
        u[[
[[i"
15 A$(5)="qw          [[[[[y      qw          [[[[[y
 qw          [
[[[[y  "
16 A$(6)="er      er      t[[[[[      er      er
t[[[[[      e
r      er"
17 A$(7)="[[[[[y      qw      qw      [[[[[y      qw
      qw
  [[[[[y"
18 A$(8)="er      er      er      er      er      er
      er      er      "
19 D=30:C=1:C1=1:D1=30:Z=30:Z1=30:V=1:V1=1:A=9:B=23:Z$
=" "
20 '0,3;CHR$(27);"@";MID$(A$(1),D,35);
21 '0,9;CHR$(27);"@";MID$(A$(2),C,35);
22 '0,7;CHR$(27);"@";MID$(A$(3),D1,35);
23 '0,5;CHR$(27);"@";MID$(A$(4),C1,35);
24 '0,13;CHR$(27);"B";MID$(A$(5),Z,35);
25 '0,15;CHR$(27);"C";MID$(A$(6),V,35);
26 '0,17;CHR$(27);"B";MID$(A$(7),Z1,35);
27 '0,19;CHR$(27);"C";MID$(A$(8),V1,35);
28 PLDT1,26,"SCORE:"+PLOT7,26,STR$(S)
29 PLDT30,26,"LIVES:"+PLOT37,26,STR$(LIVES)
30 PLDT13,26,"HI-SCORE:"+PLDT22,26,STR$(HS)
31 IF B<10 THEN Z$=CHR$(SCRN(A,B)) ELSE Z$=" "
32 K$=KEY$
33 IF K$="N" AND A>1 THEN PLDTA,B,Z$:A=A-1
34 IF K$="A" THEN PLDTA,B,Z$:B1=-2:L=1
35 IF K$="M" AND A<37 THEN PLOTA,B,Z$:A=A+1
36 IF B1=-2 THEN S=B+10:PING
39 A=A+A1:B=B+B1:IF B=1 THEN 6000
40 IF B>12 THEN 47
41 IF B=11 THEN 50
42 IF SCRN(A,B)=32 THEN 7000
43 IF L=1 THEN 50
44 IF B=5 OR B=9 THEN A=A-1:PLDTA,B,"]"
45 IF B=3 OR B=7 THEN A=A+1:PLDTA,B,"]"
46 BDT050
47 IF B=23 OR B=21 THEN 50
48 IF SCRN(A,B)<>32 THEN 7000
24 FORN=1TO2:PLDTA,B,"]":NEXTN
50 FORN=1TO2:PLDTA,B,"]":NEXTN
```

(continued on page 89)

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(continued from page 87)

```
60 IF A<=2 OR A>=37 THEN 6001
80 D=D-I:C=C+1:O1=D1-1:C1=C1+1:Z=Z-1:Z1=Z1-1:V=V+1:V1=
V1+1
82 IF D=5 THEN D=27
83 IF C=15 THEN C=1
84 IF D1=5 THEN D1=25
85 IF C1=23 THEN C1=5
86 IF Z=5 THEN Z=28
87 IF Z1=5 THEN Z1=34
88 IF V=30 THEN V=2
89 IF V1=35 THEN V1=4
90 B1=0:A1=0:L=0:GOTO20
1000 LORES0:PAPER0:INK7:POKE618,10:CLS
1001 FORA=0TO7:POKE46080+A+(8*ASC("["")),63:NEXTA
1002 FORT=0TO1:PRINT"[[[   [[[[   [[[[   [[[[   [[[[
 [[[":NEXTT
1003 FORN=1TO9:PRINTCHR$(27);"T":NEXTN
1004 FORN=1TO2:PRINTCHR$(27);"Q":NEXTN
1005 FORT=1TO8:PRINT:NEXTT
1006 FORT=0TO2:PRINTCHR$(27);"U":NEXTT:IF K=1 THEN RET
URN
1007 FORA=0TO7:READD:POKE46080+A+(8*ASC("q")),D:NEXTA
1008 DATA0,7,8,16,63,63,20,8
1009 FORA=0TO7:READD:POKE46080+A+(8*ASC("w")),D:NEXTA
1010 DATA0,0,32,16,62,63,10,4
1011 FORA=0TO7:READD:POKE46080+A+(8*ASC("e")),D:NEXTA
1012 DATA0,0,1,2,31,63,20,8
1013 FORA=0TO7:READD:POKE46080+A+(8*ASC("r")),D:NEXTA
1014 DATA0,56,4,2,63,63,10,4
1015 FORA=0TO7:READD:POKE46080+A+(8*ASC("t")),D:NEXTA
1016 DATA0,6,62,^2,62,62,6,0
1017 FORA=0TO7:READD:POKE46080+A+(8*ASC("y")),D:NEXTA
1018 DATA0,24,3I,3I,31,3I,24,0
1019 FORA=0TO7:READO:POKE46080+A+(8*ASC("u")),O:NEXTA
1016 OATA3,7,9,9,9,9,7,3
1021 FORA=0TO7:READO:POKE46080+A+(8*ASC("i")),O:NEXTA
1022 OATA0,32,48,48,48,48,32,0
1023 FORA=0TO7:READO:POKE46080+A+(8*ASC("p")),O:NEXTA
1024 OATA48,56,36,36,36,36,56,48
1025 FORA=0TO7:READO:POKE46080+A+(8*ASC("o")),D:NEXTA
1026 OATA0,I,3,3,3,3,I,0
1027 FORA=0TO7:READD:PDKE46080+A+(8*ASC("l")),O:NEXTA
1028 OATA0,12,30,45,63,12,30,33
1999 RETURN
6000 IF SCRN(A-1,B)<>91 AND SCRN(A+1,B)<>91 THEN 6010
6001 IF B=1 THEN  Z$=CHR$(SCRN(A,B-1)) ELSE Z$=" "
6002 PLOTA,B,"J":WA1T50
6004 PLAY7,0,0,0:GOTD7001
6010 PLDTA-1,B,"[[[":ZAP:B=23
60II A=RND(1)*34+2
6020 H=H+1:IF H=5 THEN H=0:GOTD10000
6025 GDTD20
7000 PLAY7,0,0,0:PLDTA,B,"J":Z$=" "
7001 FORN=I2TDISTEP-1
7002 MUSIC1,1,N,15
7003 MUS1C2,2,N,I5
7004 MUSIC3,3,N,15
7005 WAIT10:NEXTN
7006 PLAYO,0,0,0
7007 LIVES=LIVES-1
7008 PLDT30,26,"LIVES:":PLDT37,26,STR$(LIVES)
7009 PLDTA,B,Z$:B=23:A=RND(I)*34+2:Z$=" ":K$=" ":IF LI
VES<>0 THEN 2
0
7011 CLS
7012 PRINT"YDU SCORED:":S
7013 IF HS<S THEN ZAP:WA1T50:GOTD9000
7014 PRINT"HIGH SCDRE HELO BY:";B$
7015 PRINT"WITH A GREAT SCORE DF:";HS
7016 PRINT"ANDTHER GO ?"
8000 K$=KEY$:IF K$="" THEN 8000
8096 GOTD9009
8002 END
9000 CLS
9001 PRINT
9002 PRINTCHR$(4);CHR$(27);"Q";CHR$(27);"N          A NE
W HIGH SCORE
!"
9003 PRINTCHR$(4)
9004 PRINTCHR$(6);CHR$(I7)
9005 INPUT"ENTER IN YOUR NAME ";B$
9006 IF LEN(B$)>7 THEN PRINT"TOO LARGE !":GOTO9005
9007 PRINT"OK ";B$;" ANDTHER GO ?"
9008 K$=KEY$:IF K$="" THEN 9008
9009 IF K$="Y" THEN LIVES=3:K=1:HS=S:S=0:GDTO9
9010 END
10000 FORT=0TO1:PLOT1,T,"[[[   [[[[   [[[[   [[[[   [[
[[   [[[":NEX
TT
10001 S=S+100:FORN=0TO2
10002 ZAP:WA1T5:NEXTN
10003 GOTO20
```


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VIC GOLF CH

Ray and Stephen Nolan tee off our golf double with a game for the Vic-20 with 8K or 16K expansion. Vikki Allsop follows through with her version of the game for an unexpanded Vic.

AT LAST HERE is a game for the Vic-20 with 8K/16K expansion, although only 6.5K long, it could therefore be converted for the +3K system. This game does not tie your fingers in knots but gives you time to think before making mistakes! Ideal for the fair weather golfer or non-player, it provides a full choice of clubs and options of fade or draw — right or left swings — for long shot positioning to avoid the random generated traps of bunkers, trees and water hazards.

Although the 18 hole course is provided each hole is randomly generated to give a new design each round. The clubs are selected to achieve distance as follows:

Keys	Keys
1 to 4 for woods	1 to 4 for distance 200-280 yards
11 to 16 for irons	1 to 6 for distance 100-200 yards
17 to 19 for irons	7 to 9 for distance 0-100 yards

Clubs 1 and 2 can be played off line by entering F or D, and the strength of 3 entered as a percentage. Putting is self explanatory by entering any decimal number between 1 and 13.

Initially the player can select his or her own handicap and one fault which may affect the run of play. Extensive use of the pre-defined key graphics is made and further colour refinements can be added but for use on a monochrome monitor a clear contrast is used for the graphic display.



Expanded golf game listing

```
10 POKE36879,59
20 PRINT"
30 PRINT          GOLF"
40 PRINT"
50 PRINT"          BY RAY & STEPHEN"
60 PRINT                 NOLAN"
70 PRINT "          COPYRIGHT 1983"
80 PRINT "          GOSUB2400
90 Z=    FOR I=1TO21 Z=Z+    NEXT
100 B=" FOR I=1TO    B=B+    NEXT
110 N=0 J=4:A=40 F1=0 A1=0 T6=1
120 DEFFNR X=   *INT  *RND( )
130 DEFFNB    =INT  9-9*RND( )    "
140 PRINT "7THE '  'S GOLF *00
150 PRINT"WELCOME TO THE LITTLE  TN15"
160 PRINT" IS AN      18-HOLECOURSE OF      PA"
170 PRINT"OFESSIONAL  STANDARD  COURS"
180 PRINT"E RECORD IS 2    UNDER  ( 60 F"
190 PRINT"LEASE        REPLACE DIVOTS # SHOW COURTESY TO
    FELLOW GOLFERS
200 PRINT"@HAVE A GOOD ROUND-SEE YOU AT THE 19TH !
210 PRINT "   HAT IS YOUR HANDICAP"
220 INPUTN:IFH =0#0#0H<38THEN240
230 PRINT"  GA RULES HANDICAP 0-30" GOTO210
240 POKE36879,100:PRINT"  D1FFICULTIES AT GOLF#
250 PRINT" 1.HOOKING
260 PRINT" 2.SLICING
270 PRINT" 3.POOR DISTANCE
280 PRINT" 4.TRAP SHOTS
290 PRINT" 5.PUTTING
300 INPUT"YOUR WORST  F F=INT F
310 H=INT N: IFF 0#N0F 6THEN310 0
320 PRINT"DON T BE SHY"  :GOTO300
330 POKE36879,39:PRINT "  SELECTION OF CLUBS"
340 PRINT"
350 PRINT"HARDAGE  CLUBS    NO.
360 PRINT"200-   00 1-4WOODS  1-4"
370 PRINT"200-100 1-5IRONS 11-15"
380 PRINT"100-0   0-9 IRONS 16-19"
390 PRINT"@TO FADE OR DRAW THE   BALL"
400 PRINT" TYPE F OR D WHEN ASKED"
410 PRINT"TO HIT STRAIGHT TYPE   RETURN"
420 PRINT"
430 PRINT"DON T HIT IT TOO HARD
440 GOSUB2000:GOSUB1410:GOSUB2400
450 REM GENERATE HOLE
460 Z=0:D=10:A=INT(RND(0)*2+1):PRINT"
470 FOR I=1TO18:PRINT"  :NEXT
480 PRINT"HOLE" ;N ;"PAR" ;A=0
490 PRINTD "YDS " ;"PAR" ;A
500 T=K+154:E=1:FOR I=1TO44:FOR J=1TO5
510 POKE 32 T+T+22*E:NEXTJ:T=T-22*E
520 U=FNR(1):S=5+U
530 IFS 40RS 80THENS=S-U:GOTO520
540 T=T+1+22*FNB( 1):E=-E:NEXTI
550 S=3:T=T+03:FOR I=1TO5:FOR J=1TO5
560 O=160:IF I=3#NDJ=2THEN0=43:O=1
570 POKE O,T=T+22*E:NEXTJ:T=T-22*E
580 U=FNR(1):S=5+U
590 IFS 3THENS=5-U:GOTO580
600 T=T-1+22*FNB(1):E=-E:NEXTI:O=69
610 FOR I=1TO4+FNA(3)
620 S=K+O+FNR(9)+22*FNA(15)
630 IFPEEK(S+32)THENPOKES,87
640 NEXT:IFO=69THENO=55:GOTO610
650 POKEK+198,148
660 X=0:Y=15:Y=39:W=(3-K-19)*11:L=1
670 IFD>450#NDD<550THEN1150
680 IFRND(1)<.5THEN1110
690 PRINT
700 GOSUB1510
710 PRINT"@CHOOSE CLUB "
720 INPUT6$:E=VAL(C$):C=INT(C+
730 IFC<0#+BC>5/OR(C>9#AND(C<20)THEN"68
740 PRINT"@NO SUCH CLUB " GOSUB1530
750 GOTO700
760 GO=0:IFC<15THEN1=100:GOTO1240
770 PRINT"@CLISTANCE" (0-190)   100(
780 INPUT$:B=VAL(B$):IFB<0#NDB>190THEN800
790 PRINT"I SAID 0-100! HELL"  GOTO780
800 B=B*100:IFB=3THENB=B#.95
810 IFL=1THENB=B#90:IFC=3THENB=B#.
820 GOSUB1530:REM DISTANCE
830 M=230-FNA(12)-(N#30):O=.7-C#0.2
840 M=INT(B#N#39/9+5/2+O
850 A=A+1:PRINT"          CHR$(A+40)
860 IFRND(1)<.3#K/30THEN910
870 O=(K+20)#RND(1)+1:L=L+500
880 IFF=2THENU=-5:GOTO900
890 O=O#1.5:U=-5:IFF=2THENU=-1
900 IFRND(1)<.5THEN0=-O
910 FY=X:THENT=(Y-X)*(Y-W):GOTO930
920 T=ATN(Y-W)/(X-W):T=-O-OO
930 U=X+SGN(X-W)*SIN(T)*(C+.5)*TR
940 V=Y-SGN(Y-X)*COS(T)*(C+.5)*W
950 TR=1
960 IFX>430RX<80RY>235THEN1200
970 S=K+INT(X/2)+22*INT(Y/2)-T+PEEK(S)
980 U=126:IF >RND(1)*1#THENU=123
990 IF  (RND(1)*1#AND(RND(1)*1 THENU=100
1000 IF (.4#AND(1)*1#AND(Y#AND(1)*40)>THENU=124
1010 POKEZ,O:POKES,U:O=T-2*5
1020 FOR I=1TO9:POKES,O:FORJ=1TO99:NEXTJ
1030 POKES,U:FORJ=1TO99:NEXTJ
1040 GOSUB1530:IFK<>RNDY#1THEN1390
1050 IFG=160ORG=43THEN1540
1060 IFO=102THENL=2:GOTO2190
1070 IFO=8THEN2240
1080 IFO=193THENL=4:GOTO2400
1090 IFO=154THEN2440
1100 L=1:GOTO780
1110 U#=55+FNR(1):  T=1:FORI=0TO4
1120 IFPEEK(X+22*I+U)=32THENU=U+264:T=-1:GOTO1140
1130 NEXT
1140 FORI=1TO12:POKEU+T+22*FNR(5)-FNA(5):!99:NEXT:GOTO650
1150 C#K+7:U=1
1160 IFRND(0)<.5THENC=C+7:U=-1
1170 FORI=1TO17
1180 POKEC,1+0:IFRND(1)<.4THENC=C+U
1190 C=C+22:NEXT:GOTO690:REM WATER
1200 IFX<45THEN1250:REM O.O.B.
1210 IFK<4>THEN1=43
1220 IFV=0#RNDV-36THEN1300
1230 IFV>35#NDV=0#THENV=35:GOTO1300
1240 IFV<0#NDV=-11THENV=0:GOTO1300
1250 GOSUB1570
1260 PRINT"TOO MUCH CLUB-LOST   BALL
1270 PRINT"PENALTY OF 1STROKE  "
1280 GOSUB1510
1290 PRINT"IT  GOTO1910
1300 GOSUB1510
1310 PRINT"OUT OFF BOUNDS-DROP   BALL"
1320 PRINT"PENALTY OF 1STROKE"
1330 GOTO870
1340 PRINT"FADE  S DRAW
1350 INPUT"  LOOOOL AS
1360 IFA=    HEN
1370 IFA#=1 THEN000=.15
1380 GOTO690
1390 PRINT"YOU HOLED OUT   !
1400 PRINT"LUCKY!     GOTO1940
1410 FORE=0TO9:SQ:PRINT"  R TATION  USED
1420 PRINT
1430 PRINT"@ROUGH"
1440 PRINT"@TRAPS  KEEP OUT  "
1450 PRINT" FAIRWAY"
1460 PRINT"  GREEN"
1470 PRINT"THE HOLE"
1480 PRINT"@THE TEE  OF COURSE!
1490 PRINT"  WATER  LOST BALL!"
1500 PRINT"  TREES  RETURN
1510 FRINT"  .  PRINTZ  PRINTZ
1520 PRINT"  RETURN
1530 FORI=1TO2000:NEXT:RETURN
1540 PRINT"ON THE GREEN IN" A
1550 IFRND(1)<.5THENJA=1:GOTO1590
1560 IFRND(1)<.5THENJA=1.2":GOTO1580
1570 PRINT"  TAB(5)"BELOW GREEN" JA=." GOTO1590
1580 PRINT"  TAB(5)"PAST GREEN"
1590 ***  S PUTS THIS":GOSUB1530:GOSUB1510
1600 GOSUB1530:GOSUB1510
1610 FORI=22704:POKEI,1:99:NEXT
1620 POKE1+15,9,POKE1+7,POKE1+9,7
1630 POKE1+20,1
1640 D=INT(RSORY*X+1  1=  Y-W T2  31
1650 IFD 58THEND=56+FNA
1660 POKE1+15-INT(D/4),21
1670 PRINT"NOW YOU ARE" D"FEET FROM   THE PIN"
1680 PRINT"@CHOOSE PUTTING          STRENGTH  0-1
1690 INPUTC#
1700 C=VAL(C#)
1710 IFC 0#+BC  13THENR=A+1:GOTO1730
1720 PRINT"T  A  TT  GOTO1680
1730 E=C#(4#0#RND(1)  -2.5*(RND(1)0.N#30)/40:O#(K E=INT E#JA  M=M# 3
1740 FORI=1TOE D=D-1 S=INT(KK+15-D#T 4)
1750 FORJ=1TO1:NEXTJ
1760 POKES,31:POKES-1,32
1770 IFS  #K#15THENPOKEK#,15,93
1780 NEXTI:REM #0#INSERT RUN OF GREEN
1790 IFD<0THENT=-T:D=-D
1800 IFS=#K#15THENFOR1=1TO99:NE.T:POKES,93:GOTO1820
1810 GOSUB1530:GOSUB1510:GOTO1670
1820 GOSUB1530:REM PUTTING
1830 PRINT"YOU RE DOWN IN" A
1840 OH M-F#J GOTO1880:1870 1860 1910 1910
1850 PRINT"     -KEEP YOUR HEAD DOWN" GOTO1920
1860 PRINT"     A FINE NICE GOING" GOTO1920
1870 PRINT"     -A BIRDIE WELL PLAYED!  GOTO1920
1880 IFR=3THEN1500
1890 PRINT"     -A GREAT BIG EAGLE!!!" GOTO1920
1900 PRINT" A HOLE IN ONE !!!!"
1910 PRINT
1920 P1=P1+R:PA=A1+A:IFI=1THEN1970
1930 A#="UNDER" :FAL R:THEN#="OVER"
1940 PRINT"@@ YOU ARE" ABS(P1-A1)
1950 PRINT#  " PAR   AFTER" N "HOLES
1960 GOTO1980
```

IAMPIONSHIPS



UNEXPANDED

THIS IS A program for the unexpanded Vic-20. The first part, Golf Chars, contains the title, instructions and data for special characters. This must be entered and run first and should be Saved on cassette before typing New and entering the second part, Golf Game. The program uses nearly all the available memory, so do not add any spaces when typing in. Some of the lines are very long and must be entered using the standard abbreviations.

The game consists of a series of nine holes, which will be different every time. The object is, of course, to get the ball into each hole in as few strokes as possible. The fairway is shown in plain green, the bunker in yellow and the water hazard in blue. The hole is marked by a flag in the centre of the green. The ball can be hit in any direction, including diagonally, but only when the man is next to it. The direction of the hit is determined by the relative positions of man and ball, the latter moving directly away from the man.

When the man is in the position you want, press T and then enter the required club size, which will be a number from 1 to 9. Numbr 1 will hit the ball furthest. If the ball is in the rough it will not move as far as it would on the fairway and if you try to use your putter — number 9 — from the rough it will not move at

(continued on page 93)

Listing 1. Unexpanded golf game.

```
 1 PRINT"■■■■■■■■ THE VIC OPEN ■■■■" PRINT"■■■■■■■■-HOLE GOLF GAME"
 3 PRINT"■■■■■■■■■■■■■■■■■■■■"
 5 PRINT"■■■■■■■COPYRIGHT V. ALLSOPP  ■          1983"
 10 V=36878 POKEV,15
 I1 READN,D IFN=-1THENPOKEV,0 POKEV-2,0 POKEV-3,0 GOTO20
 12 POKEV-3,N POKEV-2,N FORT=1TOD NEXT GOTOI1
 15 DATA195,200,207,200,215,600,0,200,195,200,215,200,209,600,0,200
 I6 DATA215,400,207,400,195,400,175,400,-1,-1
 20 POKE51,0 POKE52,28 POKE55,0 POKE56,28 CB=7168
 25 READA IFA=-1THEH40
 30 FORN=0TO7 READB POKECB+N+0■A,B NEXT
 35 GOTO25
 40 PRINT"■■■■■    DO YOU REQUIRE      ■INSTRUCTIONS? (Y/N)"
 50 GETA$ IFA$=""THEN50
 55 IFA$="Y"THEN70
 60 IFA$="N"THENPRINT"■■O.K. PLEASE TYPE  NEW ■AHD LOAD AND RUN       ■ GOLF GAME
 "."
 65 PRINT"■■GOOD LUCK!" END
 70 PRINT"■■■■■MOVE THE MAN TO THE   ■BALL USING KEYS -"
 75 PRINT"■A - UP     Z - DOWN     ■N - LEFT  M - RIGHT"
 00 PRINT"■KTHE BALL WILL MOVE   ■DIRECTLY AWAY FROM THE■MAH WHEH HIT.)"
 85 PRINT"■■■PRESS SPACE TO CONT."
 90 GETA$ IFA$<>" "THEN90
 95 PRINT"■■WHEN MAN IS IN CORRECT■POSITION, PRESS 'T',  ■YOU WILL BE ASKED TO"
 I00 PRINT"■EHTER CLUB SIZE (A NO.■FROM 1 TO 9). 1 IS THE■HEAVIEST CLUB AHD 9 IS
"
 I05 PRINT"A PUTTER WHICH ONLY   ■MOVES THE BALL ONE     ■SQUARE."
 I10 PRINT"■■■PRESS SPACE TO CONT."
 115 GETA$ IFA$<>" "THEN115
 120 PRINT"■■TRY TO KEEP THE BALL  ■ON THE FAIRWAY AND     ■AVOID THE HAZARDS."
 122 PRINT"■PAR FOR THE COURSE IS ■36 STROKES."
 125 PRINT"■■■NOW TYPE 'NEW' AND     ■LOAD AND RUN           ■'GOLF GAME " PRINT"■
QGOOD LUCK" EHD
 I010 DATA0,0,0,0,24,24,0,0,0
 1020 DATA20,16,24,28,30,16,16,16,16
 1030 DATA35,24,24,60,90,90,60,36,102
 1040 DATA36,24,60,I26,255,255,126,60,24
 I050 DATA37,24,24,24,24,24,24,24,24
 1060 DATA26,255,255,255,255,255,255,255,255
 I070 DATA1,3,15,63,63,127,127,255,255
 1080 DATA2,192,240,252,252,254,254,255,255
 1090 DATA3,255,255,254,254,252,252,240,192
 1100 DATA4,255,255,127,127,63,63,I5,3
 I110 DATA32,I7,34,68,136,17,34,68,136
 I120 DATA5,252,126,126,63,63,126,126,252,-1
```

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Listing 2. Expanded golf game.

```
0 REM FOR  BY READ INVERSE POUND SIGN
1 REM GOLF  4MK
4 REM COPYRIGHT
7 REM (C) ALLSOFT 1983
10 POKE36872,217 PRINT"□" MM0 SR=0 C=30720
40 POKE36869,255 MM=0 0
50 PRINT "□" SC=0
60 MM=INT RND(1 #5 +1 B=INT END (1+5  B=14-A-3 MM=1 POKE198,0 #PRINT"MM0000000000"
0 GOTO60
61 IFB.5THEN2=7700 V=23 V=0 GOTO70
65 Z=8010 V=21 V=2
70 FORM=0TOB STEP2 M=21+ POKEM+1,216 POKEC1+M,5
75 POKEM+1,160 POKEM=45,160 POKEM=67,160
80 POKEM+23,16 POKEC+65M,5 NEXT
85 IFB=8THEN110
90 FORX=1TOV=8STEPV M=Z+V+MX POKEM,216 POKEC+M,5
95 POKEM+1,160 POKEM=44,160 POKEM=66,160
100 POKEM+23+MX,216 POKEC1+Z+M+1,5 NEXT
110 FORM=8TOO M=Z+M+MB POKEM,216 POKEC+Z+M,5
115 POKEM+24,160 POKEM=46,160 POKEM=68,160 NEXT
120 FORM=8TOO-1 M=Z+M+MBX POKEM+89,216 POKEC+88+M,5 NEXT
```

(continued from pege 91)

all. It can also hit trees, get stuck in the bunker or lost in the water but it cannot be hit off the screen, nor will it scroll around the sides. The man cannot stand on the trees or the flag or in the water.

Progrem structure.

Golf characters

Lines	1 to 5	Title
	10 to 16	Play tune
	20	Lowers top of Basic to protect character data
	25 to 35	Reads data for characters
	40 to 125	Instructions
	1010 to 1120	Data for charecters

Golf gama

Lines	1 to 3	Copyright
	10 to 220	Initialise variebles and set up screen
	400 to 420	Keyboard scan
	1000 to 1030	Subroutine to move man
	2000 to 2030	Subroutine to move ball
	4000 to 4010	Subroutine to print score
	4500 to 4515	Subroutine for ball in water
	5000 to 5040	Subroutine giving scores for nine holes

```
130 F=2+62+(V-1)*B POKEF,28 POKEC+F,0
140 POKEF-1,26 POKEF+t,26 POKEF-22,26 POKEF+22,26
t45 POKEC+F-1,5 POKEC+F+1,5 POKEC+F-22,5 POKEC+F+22,5
150 W=2+22*Y+A POKEW+25,37 POKEC+25+W,2 POKEW+3,36 POKEC+3+W,5
160 W=Z+A+V*B POKEW+2,37 POKEC+2+W,2 POKEW-20,36 POKEC-20+W,5
170 POKEF-23,1 POKEF-21,2 POKEF+2t,4 POKEF+23,3
t75 POKEC+F-23,5 POKEC+F-21,5 POKEC+F+21,5 POKEC+F+23,5
176 tFA>2THEN180
177 POKEF-2,5 POKEF+C-2,6 POKEF-24,5 POKEF+C-24,6 POKEF+20,5 POKEF+C+20,6
100 W=2+(V-1)*B POKEW+80,1 POKEC+80+W,7 POKEW+81,2 POKEC+01+W,7
190 POKEW+102,4 POKEC+102+W,7 POKEW+103,3 POKEC+103+W,7
193 FORX=7680TO8098STEP22 POKEX,230 NEXT FORX=7701T00119STEP22 POKEX,230 NEXT
200 FRINT"■HOLE NO."H
210 B=2+45 BC=B+C POKEB,0 M=7724 MC=M+C POKEM,35 POKEMC,2 POKEBC,0
220 H=230 NC=1 Q=160 QC=1 V=36878
400 P1=PEEK(t97) IFP1=t7TNENDM=-22 GOSUB1000
405 tFP1=33TNENDM=22 GOSUBt000
410 IFPt=28THENDM=-t GOSUB1000
415 IFP1=36THENDM=1 GOSUB1000
420 IFP1=50THENGOSUB2000
430 POKE198,0 IFP=20THENP=0 GOTO50
440 GOTO400
600 FORX=tTO6000 NEXT POKE36869,240 PRINT"□" END
1000 IF(M+DM)<7702OR(M+DM)>8185THENDM=0 RETURN
t0t0 P2=PEEK(M+DM) IFP2=0ORP2=36ORP2=37ORP2=23ORP2=5THENDM=0 RETURN
1020 POKEM,N POKEMC,NC N=PEEK(M+DM) NC=PEEK(MC+DM) POKEV,15 POKEV-2,200 POKEV-2
0 POKEV,0
t030 M=M+DM POKEM,35 MC=M+C POKEMC,2 RETURN
2000 DB=B-M IFDB=1ORDB=-1OR(DB)-24ANDDB<-20)OR(DB>20ANDDB<24)THEN2004
2001 RETURN
2004 POKE198,0 INPUT"■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■CLUB St2E",CL PRINT"■" IFCL<1ORCL>9
THEN2004
2005 tFQC=2470RQC=2310RQC=1670RQC=70RQC=390RQC=230RCL=9THENR=1 GOTO2009
2008 R=10-CL+INT(RND(1)*(12-CL),'2)
2009 IFQ=32THENR=R-1
2012 SC=SC+1 PRtNT"■■■■■■■■■■■■■STROKES",SC
2014 W=B+R*DB
2015 P=PEEK(W) IFP=36ORP=37THENW=W-DB GOTO2015
2020 tFW<7724ORW>8163THENW=B RETURN
2023 FORX=BTOWSTEPDB P=PEEK(X) IFP=230TNENW=X-DB GOTO2025
2024 NEXT P=PEEK(W)
2025 tFW=MTHEN W=W-1
2026 POKEV,15 FORX=1TO2 POKEV-1,240 NEXT POKEV-1,0 FORX=0TO200 NEXT
2027 FORX=220TO220-10*RSTEP-2 POKEV-2,X NEXT POKEV,0 POKEV-2,0 IFP=5THENGOSUB45
00
2028 IFW=MTNEN W=W-1
2029 IFP=28TNENGOSUB4000 RETURN
2030 POKEB,Q B=W Q=PEEK(B) POKEB,0 POKEBC,QC BC=B+C QC=PEEK(BC) POKEBC,0 RETURN
4000 POKEV,15 POKEV-1,240 FORX=1TO2 NEXT POKEV,0
4005 PRtNT"□■HOLE NO."H"COMPLETED  MIN"SC,"STROKES" SR=SR+SC
40t0 PRtNT"■■■■■■TOTAL "SR"STROKES" FORX=tTO5000 NEXT RETURN
4500 PRINT"■■■■■■■■■■■■■■■■■■■■■■■■■■■■tN TNE WATER - LOSE A STROKE■" SC=SC+1 W=W-1
4502 IFW=F+19TNENW=W-22
4505 POKEB,Q B=W Q=PEEK(B) POKEBC,QC BC=B+C QC=PEEK(BC)
4510 FORX=1TO3000 NEXT PRtNT"■■■■■■■■■■■■■■■■■■■■■■■■■■■■B"
4515 PRINT"■■■■■■■■■■■■■■STROKES",SC RETURN
5000 PRINT"■■■■■■YOU HAVE COMPLETED 9  ■■HOLES WITH A TOTAL OF ■■"SR" STROKES"
5010 tFSR>36THENPRINT"■■■■TNIS IS "SR-36"STROKES" PRINT"■■■OVER PAR"
5020 IFSR=36TNENPRtNT"■■■TNIS IS PAR FOR THE   ■■COURSE"
5030 tFSR<36THENPRtNT"■■■TNIS IS "36-SR"STROKES" PRINT"■■■UNDER PAR"
5040 RETURN
```

CBM64 SYNT

Duran Duran do it. Depeche Mode do it. Yazoo do it. Now you can do it too. Make beautiful music with Stephen Watson's simple synthesiser program.

WEIRD AND WONDERFUL sounds — anything from a banjo to an ondes martenot — can be made to emanate from the CBM 64 by using this simple program. It has been written in straightforward Basic to enable beginners to grasp the methods used, making it easy for them to butcher the program to their own requirements. It also contains graphic sections to aid the user in defining his own instruments.

Synth-sound 64 allows the user to play the computer like a synthesiser. It has the facility to define 12 separate instruments, four of which are already defined within the program — piano, banjo, xylophone and woodwind. It is possible to change waveforms while playing by pressing the f keys on the right-hand side of the keyboard; octaves can be selected by pressing the numerical keys 1 to 4 on the top left-hand side of the keyboard. Key 1 is the highest octave.

The program should be run and listed in the lower case mode. You will be presented with a menu showing the 12 different instrument options and asking if you wish to redefine. You can select the piano option, for example, by keying in the £ sign: when the £ sign appears on the screen, depress the plus sign — the £ sign disappears. Your keyboard is now "live", meaning that it will play the sound designated as piano when you hit the right keys. These are shown on-screen, and a mock keyboard on the screen display shows you where this would fall on a real keyboard.

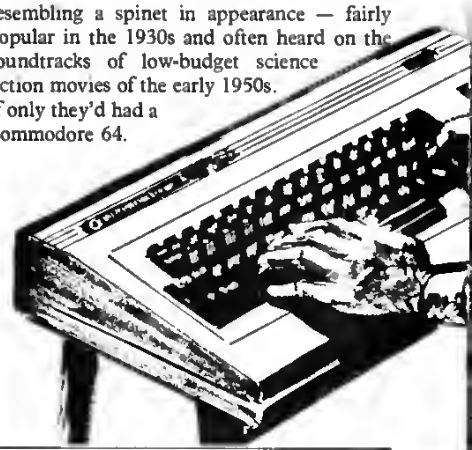
If you want to break new ground in avant-garde music by defining the sound of a goat in a room, the death throes of a neutron start, or a mighty ship ascending, press the left arrow followed by a nine and you will be asked what instrument you wish to examine out of the eight programmable ones. Once you have made your selection, the options presented are:

Attack/decay 0-255
Sustain/release 0-255
Wave-form S,T,M or P

Having defined the fundamental sound you will be returned to the menu. Key in the left arrow plus the number of the sound you just defined and your keyboard will be "live" again. Together with the four waveform keys and the four octave keys previously mentioned, you can achieve anything from a Vivaldi-type harpsichord to a drum sound worthy of Echo and the Bunneymen. Special effects, such as steam trains and gunshots are also possible.

If, while defining an instrument, you wish to leave a setting the same, just press Return only and the computer will skip over leaving the contents of that particular value unaltered and move to the next setting. While playing you can silence the voices by pressing CLR Home — unshifted — but remember that you cannot use the pulse waveform — f7 — on an instrument that has Hi and Lo pulse rates set at zero. Flags are displayed on the screen to show the user which instruments he can call on.

And, for those of you who may still be wondering, an ondes martenot is an old-fashioned electronic musical instrument resembling a spinet in appearance — fairly popular in the 1930s and often heard on the soundtracks of low-budget science fiction movies of the early 1950s. If only they'd had a Commodore 64.



```
 1 REM SYNTH SOUND - FOR "@" REPD INVERSE POUND SIGN
 2 REM ** WRITTEN BY S.R.WATSON **
 3 RD=12 SR=12 W=33 HP=0 LP=0 POKE54296 15
 4 GOSUB 1000 GOSUB 3000
 6 REM ********************
 7 REM * VOICE ROUTINE *
 8 REM ********************
 9 REM
 10 GET K$ IF K$="" THEN 10
 11 GOSUB 100
 12 IF K$="" THEN10
 13 POKE 54276,0
 14 POKE54277 AD
 15 POKE54278 SR
 16 POKE54275 HP POKE54274,LP
 17 POKE54276,W
 18 POKE54273,A POKE54272,B
 20 GET K$ IF K$="" THEN 20
 21 GOSUB 100
 22 IF K$="" THEN20
 23 POKE54283,0
 24 POKE54284 AD
 25 POKE54285 SR
 26 POKE54282 HP POKE54281,LP
 27 POKE54283,W
 28 POKE54280 H POKE54279,B
 30 GET K$ IF K$="" THEN 30
 31 GOSUB 100
 32 IF K$="" THEN 30
 33 POKE54290,0
 34 POKE54251 AD
 35 POKE54292 SR
 36 POKE54289 HP POKE54288 LP
 37 POKE54290,W
 38 POKE54287,R POKE54286,B
 39 GOTO 10
 40 REM
 41 REM ********************
 42 REM * OCTAVE 1 TABLE *
 43 REM ********************
 44 REM
 100 IF O=2 THEN 200
 101 IF O=3 THEN 300
 102 IF O=4 THEN 400
 103 IF K$="@" THEN POKE54276,0 POKE54283,0 POKE54290,0
     K$="" RETURN
 105 IF K$="2" THEN O=2 K$="" RETURN
 106 IF K$="3" THEN O=3 K$="" RETURN
 107 IF K$="4" THEN O=4 K$="" RETURN
 112 IF K$="Z" THEN A=28 B=214 RETURN
 113 IF K$="X" THEN A=32 B=94  RETURN
 114 IF K$="C" THEN A=34 B=75  RETURN
 115 IF K$="V" THEN A=38 B=128 RETURN
 120 IF K$="B" THEN A=43 B=52  RETURN
 130 IF K$="N" THEN A=45 B=198 RETURN
 135 IF K$="M" THEN A=51 B=97  RETURN
 140 IF K$="," THEN A=57 B=172 RETURN
 145 IF K$="." THEN A=64 B=188 RETURN
 150 IF K$="/" THEN A=68 B=143 RETURN
 151 REM
 152 REM       ** SHARPS **
 153 REM
 154 IF K$="S" THEN A=30 B=141 RETURN
 155 IF K$="F" THEN A=36 B=85  RETURN
 160 IF K$="O" THEN R=40 B=200 RETURN
 161 IF K$="J" THEN A=40 B=127 RETURN
 165 IF K$="K" THEN A=54 B=111 RETURN
 170 IF K$="L" THEN R=61 B=126 RETURN
 175 IF K$=":" THEN A=72 B=169 RETURN
 189 IF K$="+" THEN GOSUB 650
 190 IF K$="\" THEN GOSUB 600
 191 IF K$="@" THEN W=33 K$="" RETURN
 192 IF K$="B" THEN W=17 K$="" RETURN
 193 IF K$="N" THEN W=129 K$="" RETURN
 194 IF K$="M" THEN W=65 K$="" RETURN
 195 K$="" RETURN
 196 REM
 197 REM ********************
 198 REM * OCTAVE 2 TABLE *
 199 REM ********************
 200 IF K$="@" THEN POKE54276,0 POKE54283,0 POKE54290,0
     K$="" RETURN
 201 IF K$="1" THEN O=1 K$="" RETURN
 202 IF K$="3" THEN O=3 K$="" RETURN
 203 IF K$="4" THEN O=4 K$="" RETURN
 212 IF K$="Z" THEN A=14 B=107 RETURN
 213 IF K$="X" THEN R=16 B=47  RETURN
 214 IF K$="C" THEN R=17 B=37  RETURN
 215 IF K$="V" THEN A=19 B=63  RETURN
 225 IF K$="B" THEN R=21 B=154 RETURN
 230 IF K$="N" THEN R=22 B=227 RETURN
 235 IF K$="M" THEN A=25 B=177 RETURN
 240 IF K$="," THEN R=28 B=214 RETURN
 245 IF K$="." THEN R=32 B=94  RETURN
 250 IF K$="/" THEN A=34 B=75  RETURN
 251 REM
 252 REM       ** SHARPS **
 253 REM
 254 IF K$="S" THEN A=15 B=70  RETURN
 255 IF K$="F" THEN A=18 B=42  RETURN
 260 IF K$="O" THEN R=20 B=100 RETURN
 261 IF K$="J" THEN A=20 B=63  RETURN
 265 IF K$="K" THEN A=27 B=56  RETURN
 270 IF K$="L" THEN A=30 B=141 RETURN
 275 IF K$=":" THEN R=36 B=85  RETURN
 289 IF K$="+" THEN GOSUB 650
 290 IF K$="\" THEN GOSUB 600
 291 IF K$="@" THEN W=33 K$="" RETURN
 292 IF K$="B" THEN W=17 K$="" RETURN
 293 IF K$="N" THEN W=129 K$="" RETURN
 294 IF K$="M" THEN W=65 K$="" RETURN
 295 K$="" RETURN
 296 REM
 297 REM ********************
 298 REM * OCTAVE 3 TABLE *
 299 REM ********************
 300 IF K$="@" THEN POKE54276,0 POKE54283,0 POKE54290,0
     K$="" RETURN
 301 IF K$="1" THEN O=1 K$="" RETURN
 302 IF K$="2" THEN O=2 K$="" RETURN
 303 IF K$="4" THEN O=4 K$="" RETURN
 312 IF K$="Z" THEN R= 7 B=53  RETURN
 313 IF K$="X" THEN A= 8 B=23  RETURN
 314 IF K$="C" THEN R= 8 B=147 RETURN
 315 IF K$="V" THEN A= 9 B=159 RETURN
 325 IF K$="B" THEN A=10 B=205 RETURN
 330 IF K$="N" THEN A=11 B=114 RETURN
 335 IF K$="M" THEN A=12 B=216 RETURN
 340 IF K$="," THEN A=14 B=187 RETURN
 345 IF K$="." THEN A=16 B=47  RETURN
 350 IF K$="/" THEN A=17 B=37  RETURN
 351 REM
 352 REM       ** SHARPS **
 353 REM
 354 IF K$="S" THEN A= 7 B=163 RETURN
 360 IF K$="F" THEN A= 9 B=21  RETURN
 361 IF K$="O" THEN A=10 B=50  RETURN
 365 IF K$="J" THEN A=12 B=32  RETURN
 370 IF K$="K" THEN A=13 B=156 RETURN
 375 IF K$="L" THEN A=15 B=70  RETURN
 376 IF K$=":" THEN A=18 B=42  RETURN
 389 IF K$="+" THEN GOSUB 650
 390 IF K$="\" THEN GOSUB 600
 391 IF K$="@" THEN W=33 K$="" RETURN
 392 IF K$="B" THEN W=17 K$="" RETURN
 393 IF K$="N" THEN W=129 K$="" RETURN
 394 IF K$="M" THEN W=65 K$="" RETURN
 395 K$="" RETURN
 396 REM
 397 REM ********************
 398 REM * OCTAVE 4 TABLE *
 399 REM ********************
 400 IF K$="@" THEN POKE54276,0 POKE54283,0 POKE54290,0
     K$="" RETURN
 401 IF K$="1" THEN O=1 K$="" RETURN
 402 IF K$="2" THEN O=2 K$="" RETURN
 403 IF K$="3" THEN O=3 K$="" RETURN
 412 IF K$="Z" THEN A= 3 B=155 RETURN
 413 IF K$="X" THEN A= 4 B=12  RETURN
 414 IF K$="C" THEN A= 4 B=73  RETURN
 415 IF K$="V" THEN A= 4 B=200 RETURN
 425 IF K$="B" THEN A= 5 B=103 RETURN
 430 IF K$="N" THEN A= 5 B=105 RETURN
 435 IF K$="M" THEN A= 6 B=100 RETURN
 440 IF K$="," THEN A= 7 B=53  RETURN
 445 IF K$="." THEN A= 8 B=23  RETURN
 450 IF K$="/" THEN A= 8 B=147 RETURN
 451 REM
 452 REM       ** SHARPS **
 454 REM
 455 IF K$="S" THEN A= 3 B=210 RETURN
 456 IF K$="F" THEN A= 4 B=139 RETURN
 460 IF K$="O" THEN A= 5 B=25  RETURN
 461 IF K$="J" THEN A= 6 B=16  RETURN
 465 IF K$="K" THEN A= 6 B=206 RETURN
 470 IF K$="L" THEN A= 7 B=163 RETURN
 475 IF K$=":" THEN A= 9 B=21  RETURN
 489 IF K$="+" THEN GOSUB 650
 490 IF K$="\" THEN GOSUB 600
 491 IF K$="@" THEN W=33 K$="" RETURN
 492 IF K$="B" THEN W=17 K$="" RETURN
 493 IF K$="N" THEN W=129 K$="" RETURN
 494 IF K$="M" THEN W=65 K$="" RETURN
 495 K$="" RETURN
 496 RETURN
 594 REM
```



```
595 REM ******************************
596 REM * INSTRUMENT CHANGE ROUTINE *
597 REM ******************************
600 REM
602 PRINT"■■■■■";TAB(34),"[↖]"
605 GET O■ IF O■="" THEN 605
608 PRINT"■■■■■";TAB(34),"   "
610 IF O■="+" THEN AD=12 SR=12 W=33 HP=0 LP=0 K■="" RETURN
620 IF O■="-" THEN AD= 9 SR= 0 W=65 NP= 2 LP=255 K■="" RETURN
630 IF O■="@" THEN AD=24 SR=15 W=17 NP=0 LP=0 K■="" RETURN
640 IF O■="*" THEN AD=135 SR=15 W=17 HP=0 LP=0 K■="" RETURN
641 RETURN
642 REM
643 REM ******************************
644 REM * DEFINABLE INSTRUMENT CHANGE *
645 REM ******************************
650 PRINT"■■■■■■■■■[↓]"
651 GET X■ IF X■="" THEN 650
652 PRINT"■■■■■■■■   "
655 IF X■="9" THEN GOSUB 800
660 IF X■>"9" OR X■<"1" THEN RETURN
662 X=VAL(X■)
670 AD=AD(X) SR=SR(X) HP=HP(X) LP=LP(X) W=W(X)
671 K■="" RETURN
800 PRINT"□ONAT ↖NSTRUMENT DO YOU WISH TO EXAMINE"
810 INPUT"■                    1 TO 8 ";DE
820 IF  DE>8 OR DE<1 THEN 810
830 PRINT"□HE ↖MSTRUMENT YOU WISH TO EXAMINE IS -"
840 PRINT"■                    ";IN■(DE)
850 PRINT"■↖TS SETTINGS ARE AS FOLLOWS -"
860 PRINT"■■■                  ┌──────────┬──────┐"
870 PRINT"                     │↳▲TTACK/▽ECAY  ■■↳│";AD(DE);TAB(31);"■■│"
871 PRINT"                     ├──────────┼──────┤"
872 PRINT"                     │↳■USTAIN/_ELEASE ■■↳│";SR(DE);TAB(31);"■■│"
873 PRINT"                     ├──────────┼──────┤"
874 PRINT"                     │↳OAVEFORM      ■■↳│";W(DE)TAB(31);"■■│"
875 PRINT"                     ├──────────┼──────┤"
876 PRINT"                     │↳ION ▽ULSE RATE ■■↳│";HP(DE);TAB(31);"■■│"
877 PRINT"                     ├──────────┼──────┤"
878 PRINT"                     │↳LOW  ▽ULSE RATE ■■↳│";LP(DE);TAB(31);"■■│"
879 PRINT"                     └──────────┴──────┘"
880 INPUT "■    ▽O YOU WISH TO REDIFINE( Y/N)↳";T■
885 IF T■="Y" THEN PRINT"■■■■■■■■■" GOSUB 2010
886 IF T■="N" THEN 895
895 GOSUB 3000
900 RETURN
990 REM
991 REM ************************
992 REM * PROGRAM INTRODUCTION *
993 REM ************************
998 REM
1000 POKE53280,0 POKE53281,0
1010 PRINT"□              ↓ELLO AND WELCOME TO"
1020 PRINT"■■■                 ♦ ▽ ▌ ▌▬■┌╱╱▔ 64 ♦▌"
1030 PRINT"■↓ITN TNIS PROGRAM, YOU CAN PLAY ANY ONE"
1040 PRINT"■OF FOUR OCTAVES.  ↓OU CAN CHANGE OCTAVES"
1050 PRINT"■AT  ANY  TIME  WHILE  YOU'RE PLAYING ↓Y"
1060 PRINT"■PRESSING  KEYS ↳ 1, 2, 3 OR 4. ♦↑NERE ARE"
1070 PRINT"■ALSO  TWELVE SETS OF SOUNDS TNAT CAN ↓E"
1080 PRINT"■USED.  ▽1GHT OF THESE ARE USER DEFINABLE"
1090 PRINT"■AND CAN  ↓E SET  UP AT THE START OF THE"
1100 PRINT"■PROGRAM, OR REDEFINED WNILE TNE PROGRAM"
1110 PRINT"■IS RUNNING  BY  PRESSING  KEY '↑' & '9'"
1120 INPUT"■■■      ▽NTER '┌─┤♦╳▔' 1 TO 4 ";O
1125 PRINT"♦"
1130 IF O>4 OR O<1 THEN1120
1140 RETURN
2000 REM
2001 REM ************************
2002 REM * DEFINABLE INST' SET UP *     2003 REM ************************
2004 REM
2010 PRINT"▒▒▒▒▒▒▒▒▒▒  ▽NTER NAME FOR INSTRUMENT NUMBER ";DE
2020 INPUT"■              ";IH■(DE)
2030 INPUT "■▽NTER ▲TTACK/▽ECAY LEVEL(0-255)";AD(DE)
2035 IFAD(DE)>255ORAD(DE)<0THENPRINT"■ORRY ";AD(DE);" IS OUT OF RANGE" GOTO2030
2040 INPUT "■▽NTER ■USTAIN/_ELEASE LEVEL(0-255)";SR(DE)
2045 IFSR(DE)>255ORSR(DE)<0TNENPRINT"■ORRY ";SR(DE);" IS OUT OF RANGE" GOTO2040
2050 INPUT "■▽NTER WAVEFORM _EQUIRED (■-┤-/ OR ▽D",W$(DE)
2060 IF W■(DE)="T" THEN W(DE)=17 GOTO 2990
2065 IF W■(DE)="S" THEN W(DE)=33 GOTO 2990
2070 IF W■(DE)="N" THEN W(DE)=129 GOTO 2990
2075 IF W■(DE)="P" THEN W(DE)=65 GOTO 2100
2080 PRINT"■ORRY ";W■(DE);" NOT UNDERSTOOD" GOTO 2050
2100 INPUT"■▽NTER TNE  ↳ PULSE RATE(0-15)";HP(DE)
2110 IF NP(DE)<0 TNEN PRINT "■■ORRY, PULSE RATE TOO ▙▽O" GOTO 2100
2120 IF HP(DE)>15 TNEN PRINT"■■ORRY, PULSE RATE TOO  ↳▌ I" GOTO 2100
2130 INPUT"■▽NTER TNE ▙▽ PULSE RATE(0-255)";LP(DE)
2140 IF LP(DE)<0 TNEN PRINT "■■ORRY, PULSE RATE TOO ▙▽O" GOTO 2130
2150 IF LP(DE)>255TNEN PRINT"■■ORRY, PULSE RATE TOO  ↳▌ I" GOTO 2130
2990 RETURN
2995 REM
2996 REM ******************************
2997 REM * ↓EYBOARD/SETTINGS DISPLAY *
2998 REM ******************************
2999 REM
3000 PRINT"□■          ♦
3010 PRINT"♦          ♦ ■■■■ ▌ ▌ ■■ ▌ ▌■■ ▌ ▌■■ ▌ ■■ "                    "
3020 PRINT  "♦            ♦ ■■■■ ▌ ▌ ■■ ▌ ▌■■ ▌ ▌■■ ▌ ■■ "

3040 PRINT  "♦          ♦ ■■■■ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌ ▌■■ "
3050 PRINT  "♦          ♦ ■■■■ ▌♦▌┤─╳▌▌▌▌/▌▌▌ ▌ ▌/▌■■ "
3060 PRINT"■■┌──────────┬──────┬──────┬──────┬──────┐"
3100 PRINT "▌↳╲/■▌─↳▽/▌  ╱▔■  ■▌↳  ┌─┤♦╳▔  ╱▔▌  ■■│"
3105 PRINT "▌├──────────┼──────┴──────┴──────┴──────┤"
3110 PRINT "▌↳▽IANO        ╲ +  ■▌↳   -IRST     1   ■■│"
3120 PRINT "▌↳↓ANJO        ╲ -  ■▌↳   ♦ECOND    2   ■■│"
3130 PRINT "▌↳♦YLOPHONE    ╲ @  ■▌↳   ↓NIRD     3   ■■│"
3140 PRINT "▌↳OOODWIND     ╲ *  ■▌↳   -OURTN    4   ■■│"
3160 FOR I=1 TO 8
3165 IF IN$(I)="" TNEN IN$(I)="/OT /SED"
3170 PRINT "▌↳";IN■(I);TAB(14),"←",1,TAB(19)"■■                    "
3180 NEXT I
3190 PRINT " └──────────────────────────────┘"
3200 PRINT "▒▒▒▒▒▒▒▒▒"
3210 PRINTTAB(19)"├──────┤"
3220 PRINTTAB(19)"▌↳ O╳▔┌─┐╲  ╱▔▌  ■■│"
3230 PRINTTAB(19)"├──────┤"
3240 PRINTTAB(21)"↳■AWTOOTH     F1"
3250 PRINTTAB(21)"↑RIANGLE      F3"
3260 PRINTTAB(21)"/OISE         F5"
3270 PRINTTAB(21)"▽ULSE         F7"
3280 PRINT "■    ▽RESS  ♦↳  THEN  ▽↳  TO RE-DEFINE."
3400 RETURN
```

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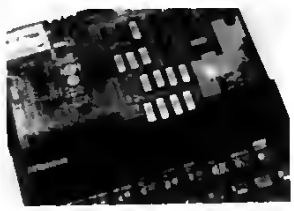


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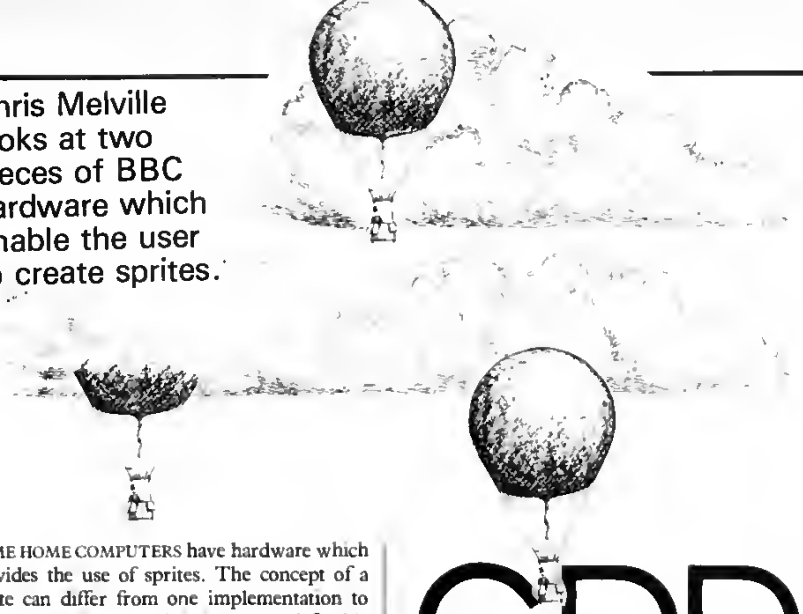
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Chris Melville looks at two pieces of BBC hardware which enable the user to create sprites.



SPRITES

SOME HOME COMPUTERS have hardware which provides the use of sprites. The concept of a sprite can differ from one implementation to another but in general it is a user-definable shape which, once defined and positioned on the screen, can be forgotten about until you want to move it — the hardware looks after it in the sense that it handles interaction with other graphics on the screen.

It may or may not, depending on the foreground/background priority of the sprite, allow the sprite to be drawn over — thus the sprite can be made to move in front of or behind other objects on the screen. If you imagine a sprite as being a sticker/transfer which you can stick at will on the front of your screen and subsequently peel it off and reposition it,then you have a fair idea of the nature of sprites.

Some systems allow you to define the sprite's screen velocity. This means that you define its shape, position and velocity and the machine hardware takes it from there. Your sprite will continue to move of its own accord across the screen, passing in front of or behind other graphics in the prescribed manner. Imagine how useful this facility is when writing a space invaders program — define an invader and set it moving, then you can forget about it, unless it reaches the side of the screen or gets hit of course.

The BBC micro was, regrettably, not given the necessary hardware to implement full sprite usage, but that does not mean that all is lost.

The colour palette can be used to make a user-defined shape appear to move in front of or behind selected colours already on the screen. Use will be made here of EOr — exclusive or — printing. The word printing does not imply that the character will only appear at text positions since use will be made of VDUs to link graphics and text cursors and enable the character to appear anywhere on the screen.

The user 6522 VIA will be used to provide regular interrupts, the handler of which will be responsible for providing the automatic moving of the above character. If you are not familiar with 6522s, interrupts or handlers Rodnay Zaks has written an excellent book *Programming the 6502.*

We will be working in mode 2 — 20K and 16 colours — as we need the full 16-colour palette so you will need a Model B, also the user 6522 VIA does not exist on Model A. This is the main reason why some Acornsoft games do not work on As since they make use of the 6522's timers as described later in the article.

MOS issue 0.1 should work since the programs and method deal with 6522 hardware directly, which precludes the use of Tube systems. We could have done the job using the concept of Events rather than interrupts but would have restricted issue 0.1 owners.

Each person's needs are different and it is impossible to provide self-contained bolt-on

(continued on next page)

Figure 1. The Mode 2 colour palette

Number		Physical colour	Logical colour
0		Black	Black
1		Red	Red
2		Green	Green
3		Yellow	Yellow
4		Blue	Blue
5		Magenta	Magenta
6		Cyan	Cyan
7		White	White
8	Flashing	Black/White	Should be redefined as required
9	Flashing	Red/Green	
10	Flashing	Green/Magenta	
11	Flashing	Yellow/Blue	
12	Flashing	Blue/Yellow	
13	Flashing	Magenta/Green	
14	Flashing	Cyan/Red	
15	Flashing	White/Black	

Listing 1.

```
   10REM DEMO1
  100CLS:PRINT"This program shows a simple example of"
 "relative movement using EOR graphics" "A coloured (r
ed/green) circle is drawn" "on the screen and you move
 a while ball" "about using the cursor keys." "One of
two things may happen:"
  200PRINT"The ball will only appear in the inner" "ci
rcle (hit  I I or it will thread between the sectors (
hit  S ) passing in" "front of green on the outside an
d behind it in the inner circle." "Hit  I  or  S ..."
   30
   40REPEAT:X%=GET# :UNTIL X%="S" OR X%="I"
   50
   60REM determine which of the available mode will be
 used
   70IF X%="S" OUTRED=14:INRED=10 ELSE OUTRED=10:INRED
=14
   80MODE2
   90REM  On the outer circle the white ball will pass
 in front of red and behind green (which we will defin
e as colours 10,11 for convenience).
  100REM On the inner circle there the red ball and th
e green ISI it will be the other way round.One way of
allocating the logical colours to attain these results
 is:
  110REM white=7,13,0
  120REM red 10,14,9
  130REM green 11,12,15
  140 REM this is new set up:
  150
  160VDU19,13,7;0;19,0,7;0;
  170VDU19,10,1;0;19,14,1;0;19,9,1;0;
  180VDU19,11,2;0;19,12,2;0;19,15,2;0;
  190
  200REM define a 4-character ball.
  210VDU23,240,3,15,31,63,127,127,255,255
  220VDU23,241,255,255,127,127,63,31,15,3
  230VDU23,242,255,255,254,254,252,240,240,192
  240VDU23,243,192,240,240,252,254,254,255,255
  250
  260 REM draw the circles
  270VDU5:PROCCIRCLE0
  280X%=500:Y%=500:VX=300:WX=500:GCOL3,7:PROCBALL(500,
500)
  290FX4,1
  300IF INKEY(-122) X%=X%+16
  310IF INKEY(-26) X%=X%-16
  320IF INKEY(-58) Y%=Y%+16
  330IF INKEY(-42) Y%=Y%-16
  340IF  INKEY(-129) GOTO 300
  350X%=(X%+1280)MOD1280:Y%=(Y%+1024)MOD1024
  360PROCBALL(VX,WX):PROCBALL(X%,Y%)
  370VX=X%:WX=Y%:GOTO300
  380
  390
  400DEF PROCCIRCLE0
  410LOCAL I%,J%
  420FOR R%=500 TO 200 STEP -300
  430MOVE640+R%,512
  440FOR I%=0 TO 360 STEP 20
  450FOR J%=I% TO I%+10 STEP2
  460MOVE640,512:IFR%=200 GCOL0,OUTRED ELSE GCOL0,11
  470PLOT85,640+R%*COS(RAD(J%)),512+R%*SIN(RAD(J%))
  480NEXT J%
  490FOR J%=I%+10 TO I%+20 STEP2
  500MOVE640,512:IFR%=500 GCOL0,INRED ELSE GCOL0,15
  510PLOT85,640+R%*COS(RAD(J%)),512+R%*SIN(RAD(J%))
  520NEXT J%
  530NEXT I%
  540ENDPROC
  550
  560
  570DEF PROCBALL(X%,Y%)
  580MOVEX%,Y%:VDU240,243
  590MOVEX%,Y%-32:VDU241,242
  600ENDPROC
```

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 ← Y
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0	3	2	5	4	7	6	9	8	11	10	13	12	15	14
2	2	3	0	1	6	7	4	5	10	11	8	9	14	15	12	13
3	3	2	1	0	7	6	5	4	11	10	9	8	15	14	13	12
4	4	5	6	7	0	1	2	3	12	13	14	15	8	9	10	11
5	5	4	7	6	1	0	3	2	13	12	15	14	9	8	11	10
6	6	7	4	5	2	3	0	1	14	15	12	13	10	11	8	9
7	7	6	5	4	3	2	1	0	15	14	13	12	11	10	9	8
8	8	9	10	11	12	13	14	15	0	1	2	3	4	5	6	7
9	9	8	11	10	13	12	15	14	1	0	3	2	5	4	7	6
10	10	11	8	9	14	15	12	13	2	3	0	1	6	7	4	5
11	11	10	9	8	15	14	13	12	3	2	1	0	7	6	5	4
12	12	13	14	15	8	9	10	11	4	5	6	7	0	1	2	3
13	13	12	15	14	9	8	11	10	5	4	7	6	1	0	3	2
14	14	15	12	13	10	11	8	9	6	7	4	5	2	3	0	1
15 ▲ X	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Figure 2. An EOR evaluator for funding X EOR Y

Listing 2.

```
   10 REM DEMO PROGRAM 2
   20 REM FOR E READ HASH CHARACTER
   30:OPTO
   40\ this program is intended to show how the timer2
 in the wheel B user 6522VIA can be harnessed to provi
de regular interupts
   50\ and how the user can set up a routine to servic
e these interrupts via the machine operating system
   60\ In this example program it is the generating of
 the interrupts which is illustrated.The handler will
 function only to make a short beep so that the user ca
n tell that interrupts are occuring.
   70\ The next program will show how the handler can
be made to move a  sprite  around automatically.
   80\IF you time the intervals between the beeps you
may notice a slight deviation in regularity.this is du
e to the clashing of our interrupts with system ones a
nd could be smoothed out by giving our interrupt handl
er first priority.
  100]
  110 PROCinitialise
  120  ?(!tiser2_high)=10000 DIV256
  130  ?(!timer2_low)=10000 MOD256
  140CLS:PRINT  "The interrupts are now occurring as yo
u will be able to tell by the pips"
  150PRINT"Try using your machine in the normal way eg
.save the program to tape,list it,type commands etc."
  200PRINT"Unless you take action which results in the
 overwriting of the interrupt handler (in which case t
he machine will crash) the beeps should continue regar
dless."
  230 END
  270DEF PROCinitialise
  280  ACR=&FE6B :REM auxilliary control register
  290  timer2_high=&FE99
  300  timer2_low=&FE88
  310  IER=&FE6E :REM interrupt enable register
  320  INFR=&FE6D :REM interrupt flags register
  330  REM initiate the VIA,create a subroutine that p
roduces a short beep (to be called from the handler),a
nd prepare the handler.
  340  PROCVIA_setup
  370  PROCbeep_setup
  380  PROChandler_setup
  400  REM set the operating systems "user-interrupt"
vector to point to the handler.
  410  ?!&204=handler MOD 256
  420  ?!&207=handler DIV 256
  450ENDPROC
  490DEF PROCVIA_setup
  500  REM this procedure sets up various flags so tha
t the &522 can start timing away as soon as timer2 is
written into.
  520  REM first enable only timer interrupts (both ti
mers are enabled)
  530  ?!IER1=&1F
  540  ?!INFR1=&FD
  550  ?!IER1=&E0
  570  REM now put timer two into "one-shot" mode.
  580  ?!ACR1=?!ACR1 AND &BF
  600  ENDPROC
  630DEF PROCbeep_setup
  640  REM this procedure assembles code that will pro
duce a short beep when called with "JSR beep".
  650  REM first set up the parameter block needed for
 the OSWORD call with A=7
  670  parse =&70
  680  !(parse+1)=&FFF1001
  690  !(parse+4)=&100C8
  710  REM now assemble the code.
  720  DIM beepspace 15
  730  P%=beepspace
  740  [OPT0
  750  .beep
  760    LDX #parse MOD 256
  770    LDY #parse DIV 256
  780    LDA #7
  790    JSR  &FFF1
  800    RTS   ]
  820ENDPROC
  870DEF PROChandler_setup
  880  REM this procedure sets up the interrupt handle
r by setting storage bytes(and initialising them),ass
embling the  handler code
  900  REM first define variable spaces
  910  count=&70 :savery=&79
  920  ?!count=0:?!savery1=0
  940  REM now assemble the code
  950  DIM handler_space 100,X %,Y %
  980  FOR pass=0 TO 2 STEP 2
  970  P%=handler_space
  980  [OPT pass%
  990    handler STX X:STY Y  \Save registers
 1000    LDA count            \See if the correct numbe
r of interrupts has occurred
 1010    CLC:ADC #1
 1020    STA count
 1030    CMP every            \This location specifies
how many interrupts should occur between beeps
 1040    BNE rat
 1050    JSR beep
 1060    rat
 1070    LDA #10000 MOD 256  \Reset the timer
 1080    STA timer2_low
 1090    LDA #10000 DIV 256
 1100    STA timer2_high
 1110    LDX X:LDY Y:LDA &FC:RTI      ]
 1120  NEXT
 1140ENDPROC
```

(continued from previous page)

procedures to suit every scheme. I will endeavour to spell out the methods that should be used and I give examples to illustrate the potential but it is up to you to apply the technique to your own programs. The submitted examples are well-documented so there should be no problem there.

Colour palette is the name used to describe the relationship between the 16 — in mode 2 — logical colours and the 16 physical colours. Imagine a painter's palette as being a wooden board with 16 pots labelled from black through to flashing black/white. This corresponds to the BBC's set of logical colours. The painter, however, has the choice of what actual paint colours he fills these pots with, and this corresponds to the physical colours on the BBC.

The default is that each paint colour — physical colour — goes into the pot labelled for its logical colour, but this can be changed by VDU19, the syntax of which should be known. Figure 1 serves as a reminder of the 16 colours.

In practice the flashing colours are not used much and we will selectively use VDU19 to replace them so that the steady colours will have alternative numbers that can be used in a GCol statement instead of the usual ones — the reason is EOr plotting.

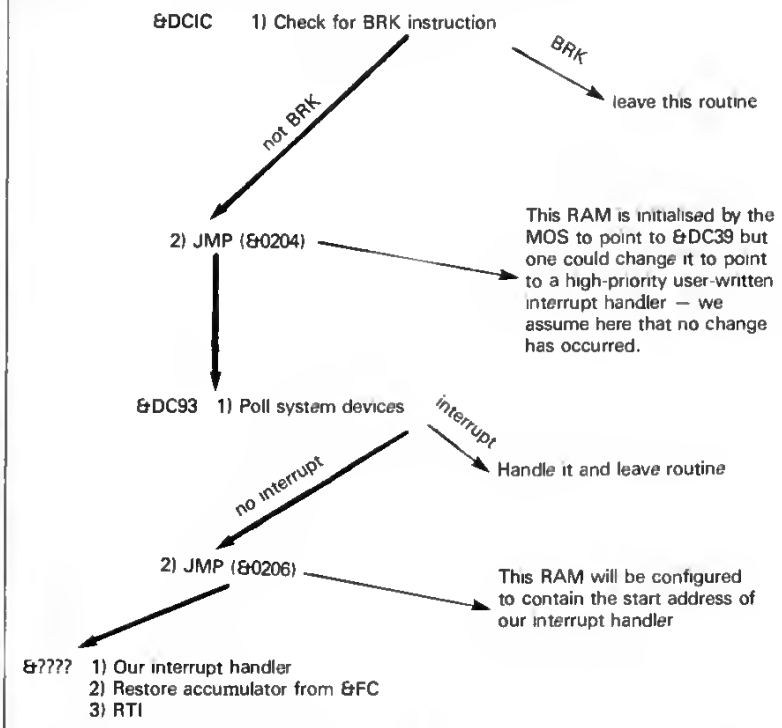
EOr printing: The bitwise logic is amply covered in other issues so I will not repeat it here. Suffice to say that EOr is used because it has the property that, for any two numbers X and Y:

(X EOR Y)EOR Y = X

that is, a number when EOred twice in succession with another number returns to the original value. When applied to graphics — Y is then the logical colour of some printed thing and X is the logical colour it is being printed onto — this has the effect that printing a figure once makes it appear in whatever colour happens to correspond to logical colour number X EOr Y and printing it again at the same place makes it disappear, since all the pixels revert to their original colour numbers.

When animating, the second or erasing step is modified. Instead of printing the same thing at the same place it is shifted a few pixels and, after a bit of arithmetic to compensate for the shift, is printed. Note that the word printing in this context takes for granted that the printing is not the usual superimposing type done under VDU5 but EOr printing. This is selected by choosing the printing colour with the command GCol3 rather than GCol0.

Figure 3. Summary of how MOS issue 1-2 handles interrupts — IRQ.



The dark arrows show the chain of events leading to the movement of the sprite via an interrupt from user VIA Timer 2.

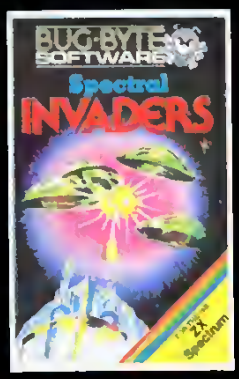
This results in the movement being made smoother but, because the interrupt handler that we will write to move our character must be as a short as possible, we will not use the shifted method but stick with the print-twice-at-the-same-place method.

Suppose we have a character which has logical colour X — so when we print it we select the colour with GCol3,X — and there are three logical colours A,B,C already on the screen, we need to know what colour will appear as a result of the EOr action when colour X is printed on each of these colours. Take colour A as an example. If it is true that A EOr X=A then the character will simply not appear when it is printed on anything with colour. This is the basis of having our character moving behind an object. On the other hand suppose that A EOr X = X. Then the character would appear in its required colour and we have foreground motion. It is obviously more likely that A EOr X will be neither A nor X so how can we fiddle this?

The answer is to manipulate the colour palette so that it does work as required. Take a real example; suppose we want a red character — red=physical colour 1 — to pass in front of a yellow region — yellow=physical colour 3. It can be seen, using figure 2, that 3 EOr 1=2, which is the physical colour number of green, is not what we want. So we perform the preliminary steps:

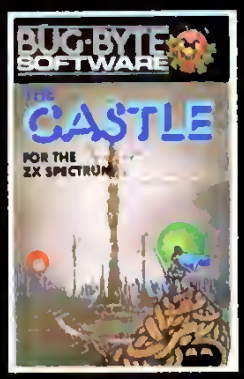
- Define logical colour 8 as red using VDU19,8,1;0;
- Observe that 8 EOr3=11 so also define colour 11 as red by VDU19,11,1;0;
- Print the character in colour 8 by doing GCol3,8 first, it will then appear in colour 11 (8 EOr 3=11) which we have just defined as red. We have thus fiddled the required result, and the character will still disappear when printed again because 8 EOr 11=3 is

(continued on page 101)

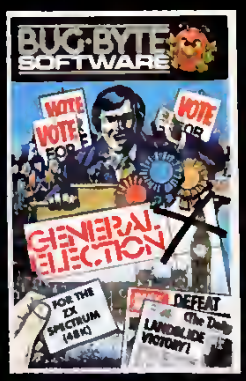


















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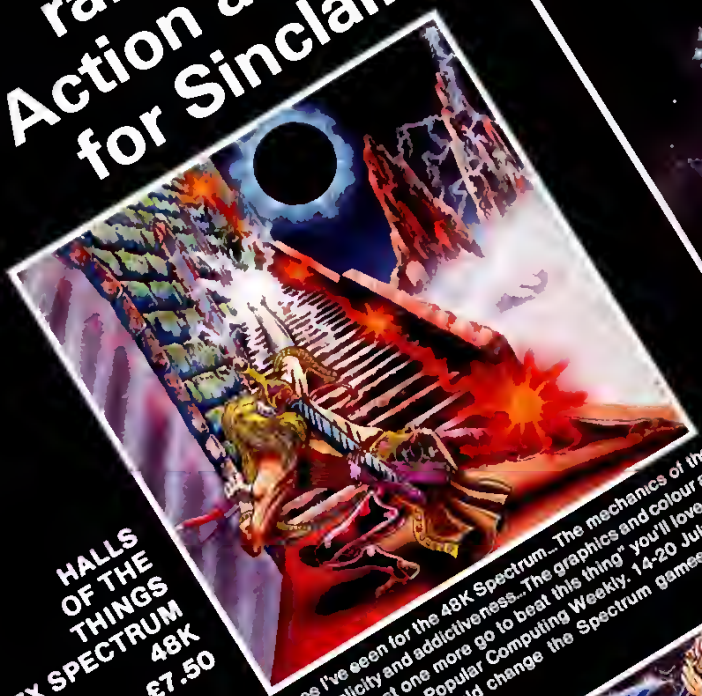
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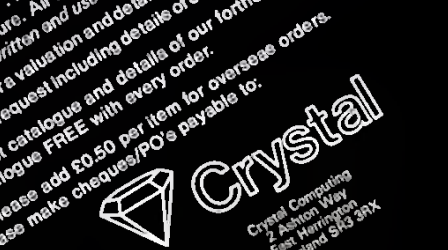
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(continued from page 98)

the original background colour.

We could have picked other numbers to redefine rather than 8 and 11. For example 9 and 10 would do since 9 EOr 3=10. The choice of numbers should be made according to which palette numbers are still unused, bearing in mind that you will probably want your red character to move in front of other colours as well and also behind some colours. The 16 possible pallette colours of mode 2 means that you do this. You will find figure 2 invaluable when choosing your pallette numbers.

Interesting results

Although the above is relatively simple, some interesting results can be obtained as in the demonstration programs. Once you have mastered this technique your future space invaders will have the power to move behind cover for added protection.

The next section deals with the automatic movement of characters using the user 6522 VIA timers to generate regular interrupts and must therefore get a little technical.

As previously mentioned, not all MOS issues support the ability to generate events every few fractions of a second. It is necesary, therefore, to get right down to the hardware and start using the hardware timers on the user 6522 VIA.

If you are already familiar with the workings of the 6522 you can skip the following description, albeit brief.

The 6522 VIA or Versatile Interface Adapter, is a chip specifically intended for use with 65** series chips, of whicb tbe 6502 microprocessor is a member. It provides the microprocessor with facilities it does not have onboard such as two interval/pulse timers, a shift register, I/O ports with handshaking, etc. The BBC MOS has one for its own exclusive use, for example, the interfacing of the 6502 to system hardware such as the keyboard. There is also a user-dedicated one.

It is our objective to use one of the two timers on the user 6522 to generate an interrupt every-so-often. We will set up the interrupt handler to move our sprite by a certain number of pixels in the x,y directions every time an interrupt occurs. The first thing we have to know, then, is how the BBC Computer deals with interrupts of the IRQ variety — NMIs should be avoided.

The 6502 microprocessor, on receipt of a low-active IRQ and assuming these are not disabled, will finish what it is doing, Save various things on the stack and then vector via &FFFE, &FFFF. In the BBC this is part of the MOS ROM and for issue 1.2 MOS the address held at these locations is &DCIC. So the net effect of an IRQ is a jump to &DCIC, wbere the MOS's handling routine begins.

Tbe action then taken is as shown in figure 3. We will change the vector at &0206 to point to our handler so that, on receipt of an interrupt it does not recognise — which the one from the user 6522 is — the MOS causes its execution.

Check for spurious IRQs

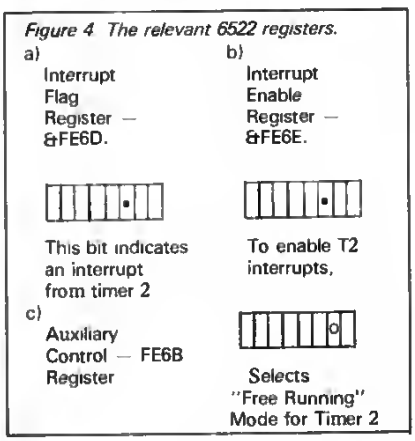
Our handler must begin by checking for spurious IRQs just to be on the safe side. It does this by examining the relevant bit in the 6522's Interrupt Flag Register — at &FE6D as in figure 4 — which indicates if the timer was the cause of the interrupt. Thus, having decided how the timer's interrupts will be handled, we now need to get it to generate them in the first place. The first step is to enable timer 2's interrupts by setting the appropriate bit in the 6522's interrupt enable register — see figure 4 part b. We want to use timer 2 — the simplest of the two timers — in one-shot clocked mode. This means that once you set it going — which occurs automatically when you write a start value into it — it counts down clock pulses until it reaches zero. It then generates an interrupt, indicating this by setting the bit in the Interrupt Flag Register. It is left to the handler to restart the timer. This also cancels the IFR's flag.

Timer is two bytes wide

We can configure timer 2 to the one-shot clocked mode by setting bit five of the 6522's Auxiliary Control Register.

Note that the timer is only two bytes wide and, since it decrements at clock frequency, can only time very short intervals. For this reason the interrupt handler will not move the sprite every time it is entered but only every so often.

Figure 4. The relevant 6522 registers.



Listing 3.

```
   10 REM DEMO PROGRAM 3
   30[OPTO
   40\ this progrom is intended to show how the timer2
 in the model B user 6522VIA can be harnessed to provi
de regular interrupts
   50\ and how the user can set up a routine to servic
e these interrupts via the exciting operating system.
   60\ In this example,these interrupts will be respon
sible for moving a character across the screen.The scr
een will be split into two windows;the character moves
ent will take place in the top window and the text cur
sors will be in the lower
   70\The user can continue to use the facilities affe
red by the computer without it affecting the sprite
 movement.
   80]
  100 MODE 2
  110 PROCinitialise
  120PRINT"Now play with the computer,eg write a small
 program or SAVE this one You will see that it behaves
 as if nothing was happening unless you try to scroll
 the screen in which case it will crash."
  140PRINT"This is due to the software scrolling and t
he graphics above intersecting."
  160  ?!timer2_high=!3000 AND&FF00
  170  ?!timer2_low=!3000 MOD256
  210 END
  250DEF PROCinitialise
  260  ACR=&FE6B :REM auxiliary control register
  270  timer2_high=&FE69
  280  timer2_low=&FE68
  290  IER=&FE6E :REM interrupt enable register
  300  INFA=&FE6D :REM interrupt flags register
  330  REM initiate the VIA,create a subroutine that w
ill move the sprites itp he called from the handler!,e
nd prepare the handler.
  340  PROCVIA_setup
  350  PROCmove_setup
  360  PROChandler_setup
  380  REM set the operating systems "user-interrupt"
vector to point to the handler.
  390  ?(&204)=handler MOD 256
  400  ?(&205)=handler DIV 256
  420  REM RET UP THE SCREEN ETC.
  430  PROCsetscreen
  450ENDPROC
  490DEF PROCVIA_setup
  500  REM this procedure sets up various flags so tha
t the 6522 can start timing away as soon as timer2 is
written into.
  520  REM first enable only timer interrupts (both ti
mers are enabled).
  530  ?!IEA=&1F
  540  ?(INFA)=&E0
  550  ?!IEA=&E0
  570  REM now put timer two into "one-shot" mode.
  580  ?ACRA=?ACR1 AND &DF
  600  ENDPROC
  670DEF PROChandler_setup
  680  REM this procedure sets up the interrupt handle
r by defining storage bytes(and initialising them),ass
embling the  handler code .
  700  REM first define variable space
  710  count=&70 :every=&79
  720  ?icount1=0:?!every1=3
  740  REM now assemble the code
  780  DIM hehvler_space 100
  760  FOR Apass=0 TO 2 STEP 2
  770  P%=handler_BARCE
  790  [OPT pass
  790  .handler PHA:TXA:PHA:TYA:PHA \Save registers
  800    LDA count             \See if the correct numbe
r of interrupts have occurred
  810    CLC:ADC #1
  820    STP count
  830    CMP every             \This location specifies
how many interrupts should occur between moves
  840    BNE ret:LDA #0 :STA count
  850    JSR move
  860  .ret
  870    LDA #1%00 MOD 256  \Reset the timer
  880    STA timer2_low
  890    LDA #13000 DIV 256
  900    STA timer2_high
  910    PLA:TAY:PLA:TAX:PLA:RTI:]
  920  NEXT
  930ENDPROC
  940DEF PROCsetscreen
  970 REM this procedure sets up a mode 2 screen,toget
her with necessary 6CR colour definitions so that the
interrupt handler can move a sprite on it
  980
  990REM First do the colour definitions according to
the following scheme:
 1000REM 11 The screen will be in cyan/blue stripes
 1010REM 21 There will be two  sprites  of colours( red
 to also appear) and yellow (faster).These will move ov
er the screen as follows:
 1020REM    a) The red moves over the cyan stripes and
behind the blue ones.
 1030REM    b) The yellow moves over the blue stripes a
nd behind the cyan ones.
 1040REM This is achieved by redefining the palette th
at we have your EOR table to  check!!
 1050REM   BLUE=logical 4,10
 1060REM   CYAN logical 8,11
 1070REM   YELLOW=logical 5,9
 1080REM   RED=logical 3,14
 1090
 1100VDU19,10,4;0;
 1110VDU19,11,6;0;
 1120VDU19,8,6;0;
 1130VDU19,9,3;0;
 1140VDU19,5,1;0;
 1150VDU19,14,1;0;
 1170REM define a walking man character in three walki
ng positions
 1180VDU 23,240,28,28,8,0,28,8,8,8
 1190VDU 23,241,28,28,8,28,8,20,20,20
 1200VDU 23,242,28,28,8,127,8,20,34,65
 1220REM now set up the screen.
 1230FOR IX=0 TO 1280 STEP 128
 1240  IF IX%0256=0 GCOL0,10 ELSE GCOL0,11
 1250  MOVE IX,768
 1260  MOVE IX,1024
 1270  PLOT85,IX+128,1024
 1280  MOVE IX+128,768
 1290  PLOT85,IX,768
 1306NEXT
 1310VDU23;11,0;0;0;0;COLOUR5
 1320VDU4,28,0,31,19,8
 1330VDU24,0;0;1280;736;
 1340 ENDPROC
 1370DEF PROCmove_setup
 1380bIM rece 400
 1390REM also reserve room for the variables that are
needed (it is necessary for the interrupt handler to r
emember the character's position)
 1400DIM rxl 0,rxh 0,yxh 0,yxl 0
 1410?(rxl)=0:?(rxh)=5:?(yxh)=5:?lyxl)=0
 1420lme=&7A:ine=&7b :REM zero_page variables
 1430?!ine=240 :REM the first man to be printed
 1440OSWRCH=&FFEE
 1450FOP pass=0 TO 2 STEP 2:P%=rece
 1460[OPT pass
 1470
 1480\ First join graphics and text cursors and work b
ut which of the three man-positions is to be printed h
ext.
 1490.move LDA #5 :JSR OSWRCH
 1500      LDA lm :STA man;CLC:ABC #1
 1510      CMP #243 :BNE m1
 1520      LDA #200
 1530.m1   STP lm
 1540      \now do a BCOL and then move the graphics c
ursor to where the last green man was.
 1550      LDA #18:JSR OSWRCH
 1560      LDA #3:JSR OSWRCH
 1570      LDA #14:JSR OSWRCH
 1580      LDA #25:JSR OSWRCH
 1600      LDA #4:JSR OSWRCH
 1610      LDA rxl:JSR OSWRCH
 1620      LDA rxh:JSR OSWRCH
 1630      LDA #182:JSR OSWRCH
 1640      LDA #3:JSR OSWRCH
 1660      \now work out new x-position of man
 1670    LDA rxl:CLC:ADC#8:STP rxl
 1680    BCC m2
 1690    LDA rxh:CLC:ADC #1:STA rxh
 1700    CMP #5:BNE m2   \check for end of line
 1710    LDA #0:STP rxh
 1720.m2 LDA man:JSR OSWRCH \overwrite last man
 1740    LDA #25:JSR OSWRCH
 1750    LDA #4:JSR OSWRCH
 1760    LDA rxl:JSR OSWRCH
 1770    LDA rxh:JSR OSWRCH
 1780    LDA #182:JSR OSWRCH
 1790    LDA #3:JSR OSWRCH
 1810    LDA lm :JSR OSWRCH
 1820\NOW REPEAT ALL OF THE ABOVE CODE FOP THE RECOND
\YELLOW CHARACTER,LOOPING TO NOT USED FOP READING OP
SPEED.
 1840     LDA #18:JSR OSWRCH
 1850    LDA #3:JSR OSWRCH
 1860    LDA #3:JSR OSWRCH
 1870    LDA #25:JSR OSWRCH
 1880    LDA #4:JSR OSWRCH
 1890    LDA yxl:JSR OSWRCH
 1900    LDA yxh:JSR OSWRCH
 1910    LDA #82:JSR OSWRCH
 1920    LDA #3:JSR OSWRCH
 1950    LDA yxl:CLC:ADC#18:STP yxl
 1960    BCC n2
 1970    LDA #0:STP yxh
 1980.n2 LDA man:JSR OSWRCH
 1990    LDA #25:JSR OSWRCH
 2000    LDA #4:JSR OSWRCH
 2010    LDA yxl:JSR OSWRCH
 2020    LDA yxh:JSR OSWRCH
 2030    LDA #82:JSR OSWRCH
 2040    LDA #1:JSR OSWRCH
 2050    LDA lm:JSR OSWRCH
 2060    LDA #4:JSR OSWRCH \return to cursors separate
mode
 2090    ATO
 2100]:NEXT
 2110ENDPROC
```

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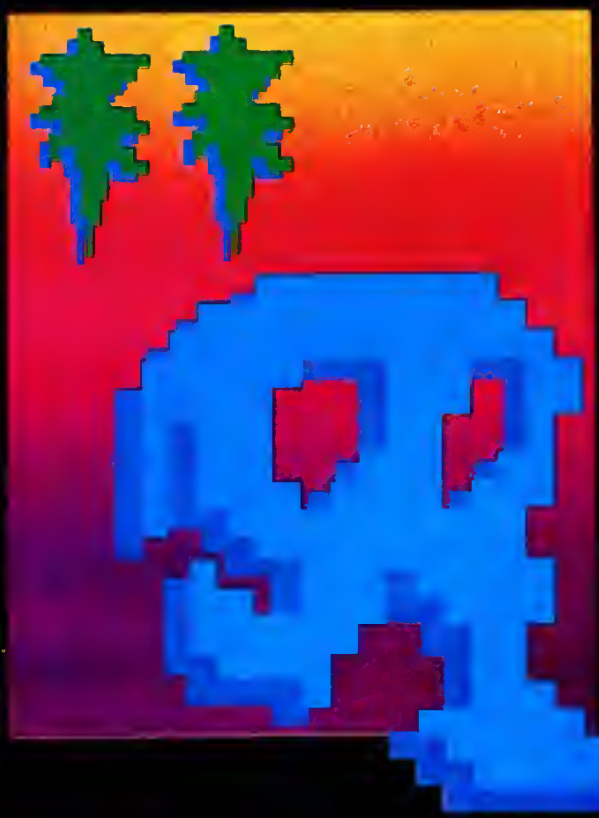
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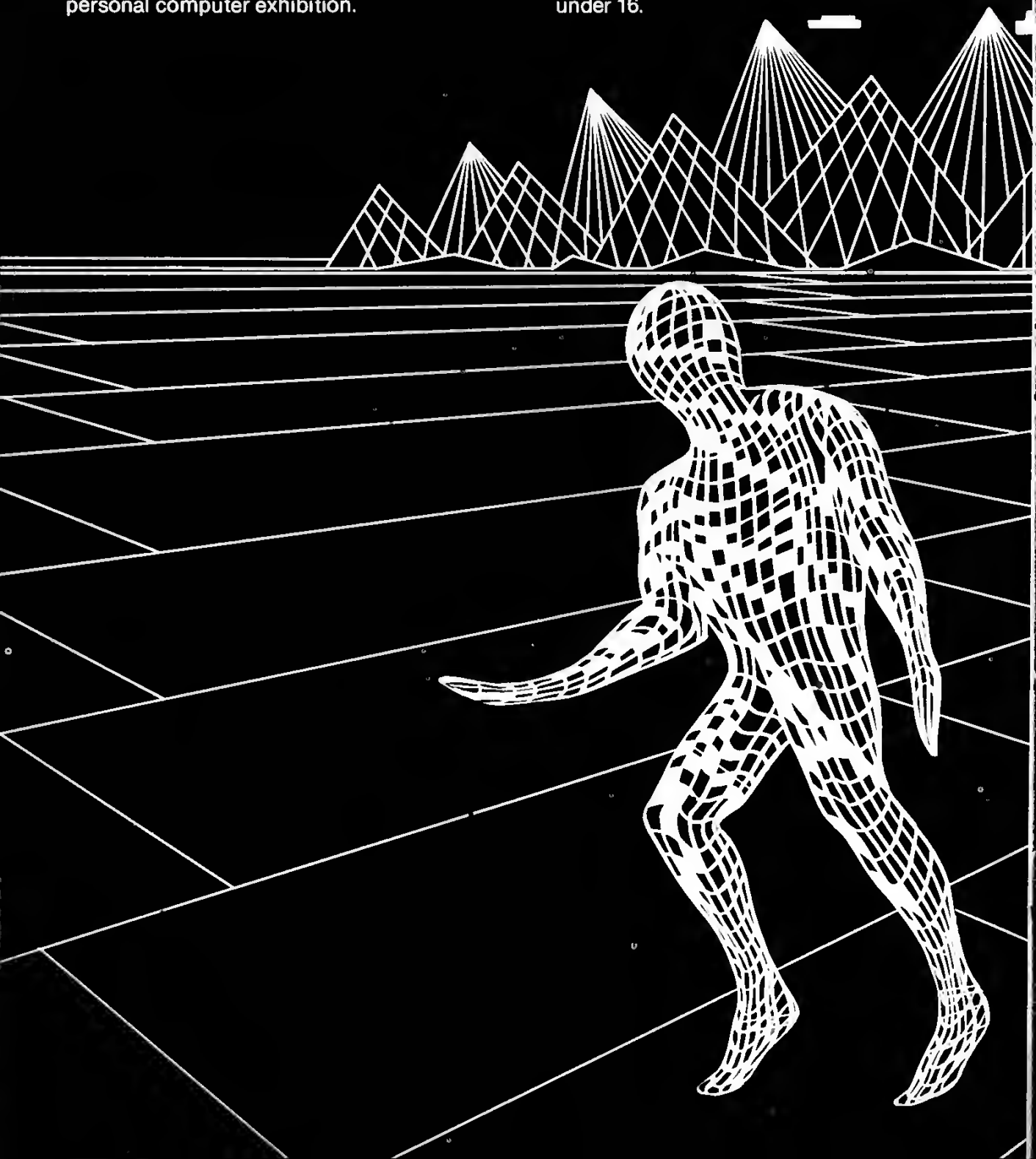
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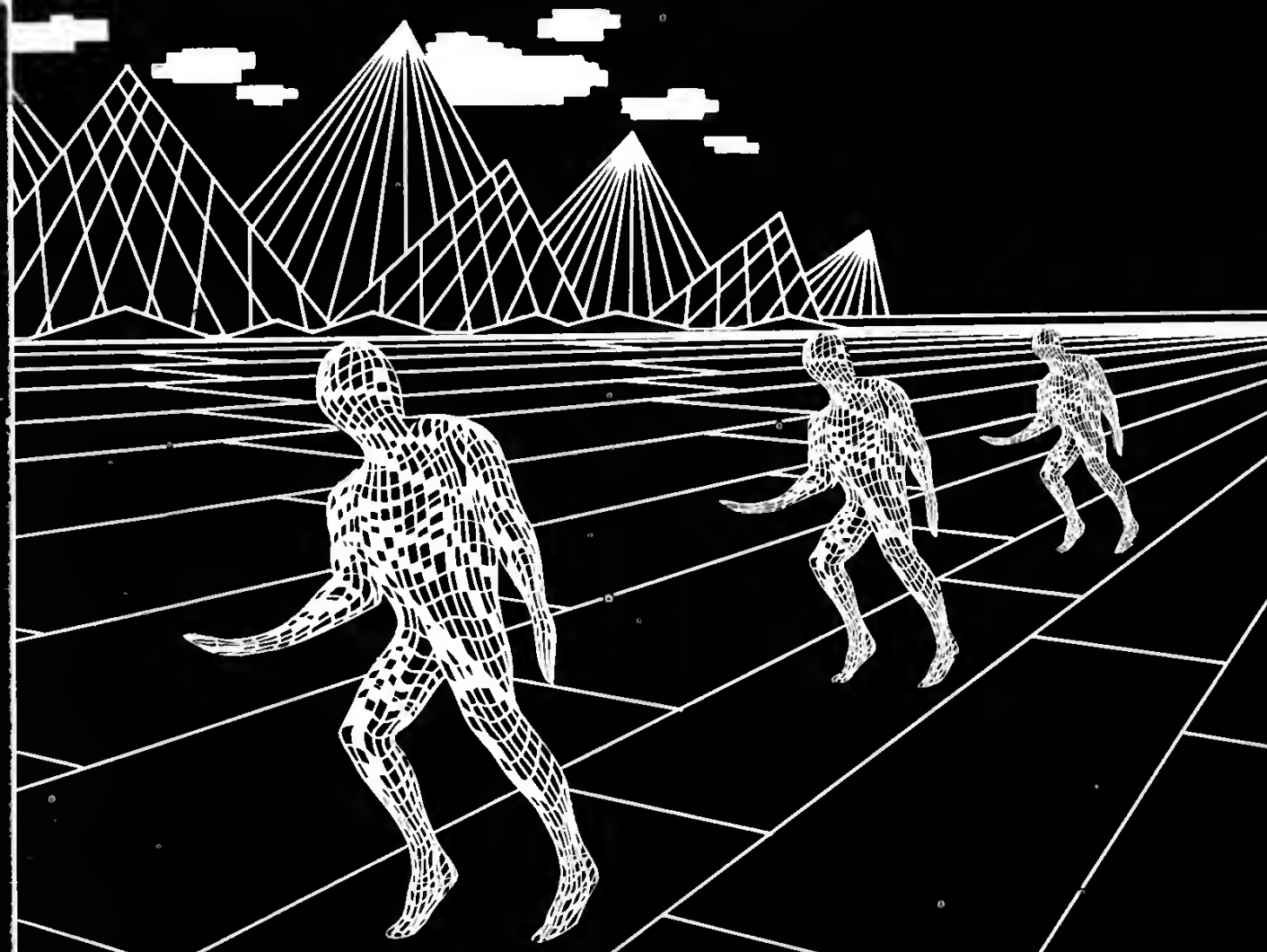
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SLIDING PUZZLE

Amuse yourself and your kids with sliding puzzles by Margaret Norman.

THE DRAGON HAS an excellent range of graphics commands, which makes it possible to produce quite elaborately coloured pictures with the minimum of programming. Unfortunately, these have been under-used in most published programs. There are two main reasons for this: the difficulty of mixing text with high-resolution graphics, and the slow speed at which some of the graphics commands, particularly the Paint command, are executed.

This program, which is the Dragon version of a children's sliding tile puzzle, uses virtually all the high-resolution graphics commands to produce a very colourful game. There is a choice of three different puzzle designs; a small guide picture is shown as well as the main puzzle picture, and the player's input — row letter and column number — and number of moves taken are also shown on screen. All this in just 180 lines of program.

The program starts with a short title sequence — lines 50 to 150 — the letters of the word Sliding slide into position from the right-hand edge of the screen, then Picture and Puzzles are printed underneath against a blue background. This is followed by the selection of the puzzle to be used — lines 170 to 190. The instructions come after this so that the first line of the instructions can be selected to match the puzzle chosen.

Strings are defined near the start of the program — lines 280 to 310 — to Draw the digits 0 to 9. This has to be done before the program branches to draw the appropriate puzzle picture, as the digits are used for the number puzzle.

All three puzzles are drawn in Pmode 3 using the green/yellow/blue/red colour set, against a yellow background with red lettering. The designs have all been planned so that when they are divided up into four rows of four squares, the top left-hand square will be plain blue. This square represents the empty tile position.

The first puzzle is drawn in lines 1060 to 1190 and shows a yellow house, with red roof and door, against a blue sky and green grass. The outlines of the picture are drawn using the string, HS, defined in line 1080. This string is used for both the main picture and the small guide picture, with different scale factors — S16 and S4 — in the Draw command.

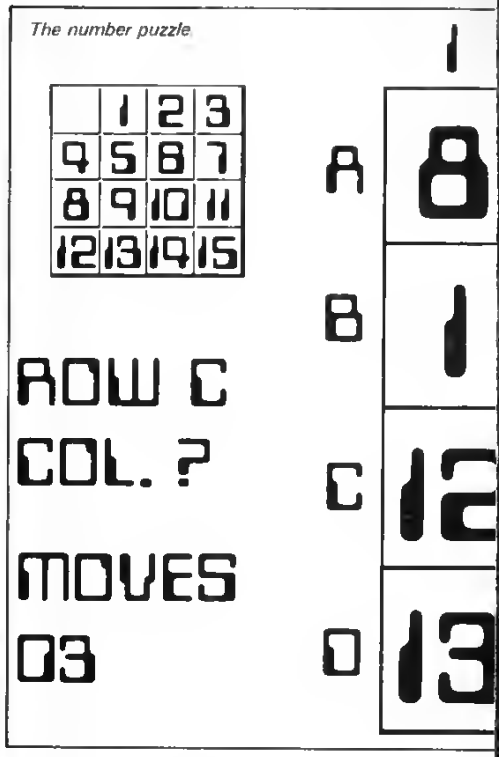
The smoke coming out of the chimney of the house is Drawn separately for the two pictures, as a simplified version is used for the small picture. The squares containing the pictures are both initially Painted green, as the picture contains more pieces in green than in any other colour; the curtains at the windows of the house are green. The other coloured pieces are Painted after the outlines have been drawn.

For the second puzzle — the number puzzle — the two squares are initially Painted blue, then the picture squares are divided up into small squares, using the Line command, and alternate small squares are Painted red. The numbers 1 to 15 are then Drawn on these squares in yellow. The pre-defined strings are used to Draw the numbers 1 to 9, but the numbers 10 to 15 are Drawn separately — lines 1320, 1330 and 1370 — as they can only just be made to fit in the squares in the small picture without becoming illegible.

The final puzzle is of a yellow Humpty Dumpty, with green hat and trousers, sitting on a red wall. Humpty's body is drawn with the Circle command, with a 1:3 height-to-width ratio — lines 1440, 1530. The Circle command is also used for Humpty's mouth, but here only half the ellipse is drawn — line 1480. Circles are also used for the eyes in the big picture, but Pset is used instead in the small picture — line 1570 — as circles with small radii look like crosses.

The arms and legs are Drawn and Painted in detail in the big picture, but are just represented by lines in the small one. The bricks on the wall have only been drawn in the big picture.

The number puzzle



The screen is not set until after the puzzle has been drawn, so that the picture will appear all at once instead of bit-by-bit. A Please Wait message is displayed on the screen while the puzzle is being drawn — line 270. If you would prefer to see the picture being drawn, change line 270 to:

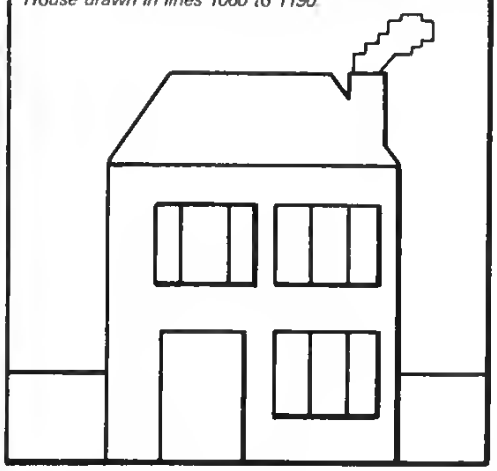
```
270 PMODE3,1:PCLS2:SCREEN1,0
```

and omit lines 1070, 1210 and 1410. If you would prefer the picture not to appear until it has been shuffled by the computer, delete line 370 and insert

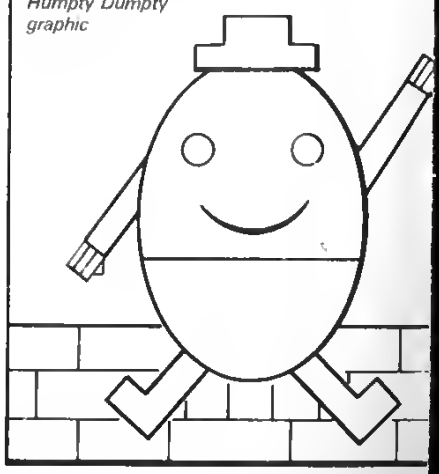
```
495 SCREEN1,0
```

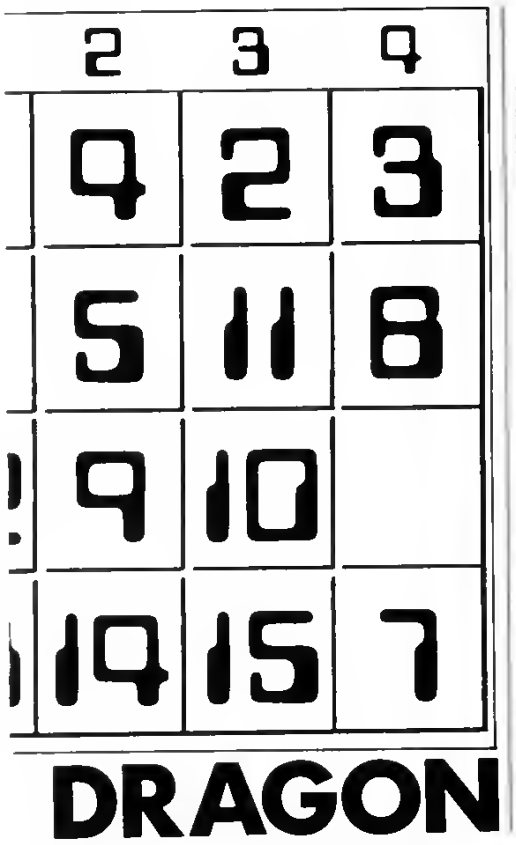
The Get and Put commands are used to move the puzzle pieces. The plain blue square is held in array B, and the picture piece being moved in array A. Note that these are both one-dimensional arrays; two dimensional arrays, as described in the Dragon manual, are not necessary. To calculate the array size

House drawn in lines 1060 to 1190



Humpty Dumpty graphic





needed to Get(X1,Y1)-(X2,Y2) in this Pmode, use the formula (X2-X1)*(Y2-Y1)/8.

The number of moves made by the computer depends on the level of difficulty selected. At the lower levels of difficulty, the computer may occasionaly shuffle the picture back to where it started. If this happens you must move one piece out of position then back again, as the computer does not check to see if the puzzle is complete until after the player has made a move. At level five the picture should be pretty well mixed up.

When the player is required to input a row letter or column number, a question mark will appear after the word Row or Col on the screen. Get and Put are used here too, for the question mark and the blank array BQ — which is also used to blank out the number of moves — but tbe numbers and letters are Drawn using previously defined strings. The number of moves the player can make is limited to 100, mainly because the subroutine which Draws the number — lines 1000-1050 — can only handle two-digit numbers.

The puzzle picture is copied before the game starts — in line 380 — so that it need not be re-drawn for subsequent games. If you want to change to a different puzzle, you must stop the program and run it again. If you would like to leave more memory space to add other pictures of your own, then omit line 380, change the 8 in line 30 to 4, omit line 830 and change line 900 to End. You will then only be asked if you want another game if you have successfully solved the puzzle.

Anyone trying to adapt this program to run on a different computer may hit problems because so many of the graphics commands used are specific to the Dragon.

List of variables

Q(I):	array used for question mark
BQ(I):	array used to blank out question mark
B(I):	array used for blank blue square
A(I):	array used for picture square
Z.	counter used for sounds in title sequence
I,J:	loop counters
A$.	letter to be Poked onto screen
A·	ASCII value of letter
DL:	delay loop counter
K.	indicates puzzle chosen
L·	level of difficulty
N$(I):	strings to Draw digits
P(I,J):	number of picture piece in square (I,J)
BC,BR:	column and row nos. of blank piece
W,W1:	used to select piece to be moved by computer
C,R.	column and row nos. of piece to be moved
M.	number of moves taken
F:	flag indicating whether puzzle was completed
XA,YA.	X and Y co-ordinates of corner of piece to be moved
XB,YB.	X and Y co-ordinates of corner of blank piece
D1,D2.	digits in M
H$:	string to Draw house
L$(I):	strings to Draw letters A-D

```
10 REM SLIDING PICTURE PUZZLE
20 REM BY MARGARET NORMAN
30 CLEAR 50:FILEAR 8
40 DIM Q(1),BQ(20),B(200),A(200)
50 CLS3
60 Z=2*N
70 FOR I=1 TO 7
80 READ A$:A=ASC(A$)
90 FOR J=1 TO(B-1)
100 POKE 1024+254+J,175:POKE1024+253-J,A
110 NEXT J
120 SOUND Z,1:Z=Z-5
130 NEXT I
140 PRINT@268,"PICTURE";:PRINT@300,"PUZZLE";
150 DATA 9,L,T,D,I,N,G
160 FOR BL=0 TO 1500:NEXT
170 CLS:PRINT@40,"PUZZLES AVAILABLE:":PRINT@99,"(1 N
OUSE":PRINT@162,"(2)  NUMBLRS":PRINT@226,"(3)  HUMPTY
DUMPTY"
180 PRINT:INPUT"WHICH WOULD YOU LIKE (1,2 OR 3)";K
190 IF K<1 OR K >3 THEN 180
200 ON K GOTO 210,220,230
210 CLS:PRINT:PRINT"REARRANGE THE PIECES TO FORM A PI
CTURE OF A HOUSE.":GOTO 240
220 CLS:PRINT:PRINT"ARRANGE THE NUMBERS IN THE ORDERGH
ONN IN THE SMALL PICTURE":GOTO 240
230 CLS:PRINT:PRINT"CAN YOU PUT HUMPTY TOGETHER     GO
AIN?"
240 PRINT"TO MOVE A PIECE ADJACENT TO THE EMPTY (PLAIN
 BLUE) POSITION,    TYPE THE ROW LETTER THEN THE    CO
LUMN NUMBER."
250 PRINT:INPUT"LEVEL OF DIFFICULTY (1-5)";L
260 IF L < 1 OR L >5 THEN 250
270 CLS:PRINT@265,"PLEASE WAIT"
280 REM NUMBERS
290 N$(0)="A5D6L4UBBR10":N$(1)="BR2R2D6L2R4BR4BUE":N$(
2)="R5D4L6D4A6BR4BU8"
300 N$(3)="R5D4NL6D4L6BR10BUE":N$(4)="06R4NU2ND2R2BR4B
U6":N$(5)="NR6DAR6B4L6BR10BUE"
310 N$(6)="D8R6A4L6BR10BU4";N$(7)="R6D8R4BU8":N$(8)="
R5D4NL6D4L4UBBR10":N$(9)="NR4D4R4U4D8R4BU8"
320 ON K GOTO 1060,1200,1400
330 FOR I=1 TO 4:FOR J=1 TO 4
340 P(I,J)=(I-1)*4+J
350 NEXT J,I
360 BC=1:BR=1
370 SCREEN1,1
380 PCOPY 1 TO 5:PCOPY2 TO 6:PCOPY3 TO 7:PCOPY4 TO 8
390 REM SHUFFLE PICTURE
400 FOR I=1 TO 1L*10!
410 W=RND(4):IF (W=1 AND N1=2) OR (W=2 AND WT=1) OR(W=
3 AND W1=4) OR(W=4 AND N1=3) THEN 410
420 N1=W    :ON WT GOTO 430,440,450,460
430 C=BC:IF BR=1 THEN R=BR:GOTO 470 ELSE R=BR-1:GOTO
 470
440 C=BC:IF BR=4 THEN R=3:GOTO 470 ELSE R=BR+1:GOTO 47
0
450 R=BR:IF BC=1 THEN C=2:GOTO 470 ELSE C=BC-1:GOTO 47
0
460 R=BR:IF BC=4 THEN C=3 ELSE C=BC+1
470 GOSUB 910
480 NEXT I
490 SOUND200,5
500 REM START GAME
510 PUT(56,80)-(76,88),,PSET
520 PUT(56,100)-(76,108),,PSET
530 PUT(56,80)-(66,88),Q,PSET
540 R$=INKEY$:IF R$="" THEN 540
550 R=ASC(R$)-64:IF R<1 OR R >4 THEN 540
560 PUT(56,80)-(76,88),,PSET
570 DRAW"BM66,80;XL4;R1;"
580 PUT(56,100)-(66,108),Q,PSET
590 C$=INKEY$:IF C$="" THEN 590
600 C=VAL(C$):IF C<1 OR C>4 THEN 590
610 PUT(56,100)-(76,108),,PSET
620 DRAW"BM56,100;XN$(C);"
630 IF(R=BR AND ABS(C-BC)=1)OR(C=BC AND ABS(R-BR)=1)
THEN GOSUB 910:GOTO 650
640 GOTO 510
650 SOUND200,2
660 N=N+1:IF N>99 THEN 870
670 GOSUB 1000
680 REM CHECK FOR PUZZLE COMPLETE
690 FOR I=1 TO 4
700 FOR J=1 TO 4
710 IF P(I,J)<>4*(I-1)+J THEN 500
720 NEXT J,I
730 REM PUZZLE COMPLETE
740 FOR I=1 TO 3:SOUND170,2:SOUND200,4:NEXT I:FOR BL=0
 TO 500:NEXT
750 CLS:PRINT@235,"WELL DONE "
760 PRINT@291,"YOU SOLVED IT IN";M;"MOVES"
770 PRINT@354,"(IT WAS SHUFFLED";L*10;")TIMES!
780 PRINT@425,"ANOTHER GO (Y/N)";:INPUT Q$
790 IF Q$="N" THEN 860
800 CLS:INPUT"LEVEL OF DIFFICULTY (1-5)";L
810 IF L<1 OR L>5 THEN 800
820 PMODE3,1:SCREEN1,0
830 IF F=1 THEN PCOPY 5 TO 1:PCOPY 6 TO 2:PCOPY 7 TO 3
:PCOPY 8 TO 4:BC=1:BR=1
840 M=0:GOSUB 1000
850 GOTO 390
860 END
870 REM FAIL
880 SOUND50,3:FOR BL=1 TO 300:NEXT
890 CLS:PRINT@229,"SORRY - YOU FAILED TO SOLVE THE PUZ
ZLE IN 100 MOVES"
900 F=1:GOTO 780
910 REM SLIDE PIECE(R,C)
920 XA=4*(P(R,C)-1)+16*(C-1)+4
930 GET(XA,YA)-(XB+40,YB+40),A,G
940 XB=4*(P(R,C)-1)+16*(C-1)+4
950 PUT(XB,YB)-(XB+40,YB+40),A,PSET
960 PUT(XA,YA)-(XA+40,YA+40),B,PSET
970 P(BR,BC)=P(R,C):P(R,C)=1
980 BR=R:BC=C
990 RETURN
1000 REM WRITE NO  OF MOVES
1010 D1=INT(M/10):D2=M-10*D1
1020 PMODE3,1:PCLS2
1030 PUT(25,155)-(45,163),,PSET
1040 DRAW"BR25,155;XN$(D1);XN$(D2);"
1050 RETURN
1060 REM DRAW PICTURE
1070 PMODE3,1:PCLS2
1080 H$="R4UNL4UE8UL6D2R8F4U4R4D8M+F4NL2D2]ANR6D4L10D1
6D1]R4L10D1BM+4UR2ND6R4ND4R2D4L8DR12U6R2ND6R4ND6R2D6
L8BD6R2ND6R4ND6R2D6L8U6":D$="U2R4U2R4D4L8D2
1110 PAINT(10,10),3,4:PATNT(24,40),2,4:PAINT(28,50),4,
4
1120 PATNT(40,30),4,4:PAINT(46,24),4,4:PATNT(46,20),2,
4
1130 PAINT(30,40),3,4:PRINT(42,40),3,4:PATNT(42,50),3,
4
1140 LINE(80,16)-(240,176),PSET,B:PAINT(82,18),1,4
1150 DRAW"BM80,176;S16;XH$;B4;BR196,40;U4E4R4E4R4E4R4F
4D4L4D4L8D4;BR136,152;R4D4L4U4"
1160 PAINT(82,18),3,4:PAINT(112,160),2,4:PAINT(160,50)
,4,4
1170 PAINT(200,50),4,4:PRINT(190,30),2,4:PAINT(120,160
),4,4
1180 PRINT(136,100),3,4:PATNT(184,100),3,4:PRINT(78,150),3,4
1190 GOTO 161#
1200 REM DRAW NUMBER PUZZLE
1210 PMODE3,1:PCLS2
1220 LINE(16,16)-(156,56),PSET,B:LINE(80,16)-(240,176),
PSET,B
1230 PRINT(18,18),3,4:PATNT(82,18),3,4
1240 FOR I=1 TO 4
1250 LINE(16+10*I,16)-(16+10*I,56),PSET:LINE(16,16+10*I
)-(156,16+10*I),PSET
1260 LINE(80+40*I,16)-(80+40*I,176),PSET:LINE(80,16+40
*I)-(240,16+40*I),PSET:NEXT I
1270 FOR I=1 TO 2:FOR J=1 TO 2
1280 PAINT(16+2*I,2+J-2),4,4:PATNT(20+I-2,8+20*J),4,
4
1290 PAINT(50+80*I,80+J-80),4,4:PAINT(80+I*10,80+J-20)
,4,4
1300 NEXT J,I
1310 DRAW"BM28,18;C2"+N$(1)+N$(2)+N$(3)+"BR18,28;"+N$(
4)+N$(5)+N$(6)+N$(7)+ BR18,38"+N$(8)+N$(9)
1320 DRAW"BM38,38;D6BR4U6R4D4L4BR6U6BR4D6"
1330 DRAW"BR18,54;U6BR2R4D3L4D3R4BR4U6BR2R4D3NL4D3L4BR
BU6BR2D4R2NU2HD2R2BR4D2UBR2NR4D3R4D3L4
1340 DRAW BM124,70;S16;"+N$(1)+N$(2)+N$(3)
1350 DRAW"BM86,60;"+N$(4)+N$(5)+N$(6)+N$(7)+"BM86,100;
"+N$(8)+N$(9)
1360 DRAW"BM146,102;D6BR3UBR4BM 4BR6U6BR4D6"
1370 DRAW BM84,166;U6BR3R4D3L4D3R4BR3U6BR3R4D3NL4D3L4B
R6U6BR3D4R2NU2ND2R2BR3U4D6BR3R4U3L4U3R4"
1380 DRAW S4;C4
1390 GOTO 161#
1400 REM DRAW HUMPTY
1410 PMODE3,1:PCLS2
1420 LINE(80,16)-(240,176),PSET,B
1430 LINE(80,125)-(240,125),PSET
1440 CIRCLE(160,46),30,4,1
1450 DRAW BM125,144;C4;BL6HBGBF16E24;BR195,140;F16EBFD
BL6H24
1460 PAINT(85,170),4,4:LINE(110,110)-(210,110),PSET:LI
NE(120,125)-(120,125),PSET:CIRCLE(160,125),7,4
1470 PAINT(123,143),4,4:PAINT(197,143),4:CIRCLE(140,
70),7,3:PAINT(148,78),3,3:CIRCLE(180,70),7,3:PAINT(180
,70),3,3
1480 CIRCLE(160,85),20,4,0.5,0,0.5
1490 DRAW BM112,80;C2;NF22NF20SF2NE5F2NE5F2E3D2R2U3E15;BM2
02,74;E2ENF2ESF2ND5F2NG5F2D3R2D2L3G2"
1500 PAINT(82,18),3,4:DRAW"BR140,40;C1;U5R5U10R30D10R5
D5L40":PAINT(160,30),1,1
1510 DRAW"BM80,145;C2;TA10ND20R10NU20R10ND10R10DU4;BM20
0,145;NU10R10ND10R10NU20R10ND20R10;BD20;L20ND15L4BL12L
4ND15L4NU15L4ND15L10NU8L10ND15L10NU8L10ND15L10NU15L1
4D15L4BL12L4ND15L2+C4
1520 LINE(16,16)-(156,56),PSET,B
1530 CIRCLE(36,36),12,4,1.3
1540 LINE(16,42)-(26,42),PSET:LINE(146,42)-(156,42),PSET
1550 PAINT(18,54),4,4:LINE-(24,38)-(152,38),PSET:PAINT(3
6,40),1,4:PAINT(18,18),3,4
1560 DRAW"BR20;R6;C1;G4H4;BM64,46;F4E4"
1570 PSET(33,34):PSET(33,31):PSET(41,30,3):PSET(41
,31,3)
1580 DRAW AM55,34;C4;F2R4E2"
1590 DRAW BM74,35;C2;D5;BM46,35;E5"
1600 DRAW"BM74,24;C1;R20U4H3D4R2L14;C4";PRINT(36,22),1
,1
1610 REM NUMBERS
1620 DRAW BM90,5;XN0111;BR137,5;XN0121;BR177,5;XN0131;B
BN217,5;XN0141
1630 REM SQUARES
1640 FOR I=1 TO 3
1650 LINE(80+40*I,16)-(80+40*I,176),PSET
1660 LINE(80,16+40*I)-(240,16+40*I),PSET
1670 NEXT I
1680 REM LETTERS
1690 L$(1) ="ND8R4D4NL6D4";L$(2) ="ND8R4F2BR2NL4F2D2L4"
:L$(3) = "NR4D8R4 :L$(4)="R4F2D4G L4U4"
1700 DRAW"BM70,30;XL$(1);BM70,70;XL$(2);BM70,110;XL$
(3);
1710 BR70,150;XL$(4);
1720 REM ROW,COL ,MOVES
1730 DRAW"BM16,80;NU8BF6D4;A4R2F4BR4UBR6DBL4BR1"+BU8D4F2E
2F2E2R4;BM16,100;NR4D8R4BM+4R4BR6DBR6;NUR6+BR4U2;AW16
,14;NDBF4E8DBR4R4UBR6DBR6;NUBD4F4E4U4BR4NR6DANR6R4R
6BR4BU4L4U4F6
1740 REM
1750 DRAW"BM56,84;BR4L2D1BR2D1"
1760 GET(56,80)-(66,88),Q,G
1770 PUT(56,80)-(76,88),,G
1780 PUT(56,100)-(76,108),,G
1790 FOR I=1 TO 4:FOR J=1 TO 4
1800 P(I,J)=4*(I-1)+J:NEXT J,I
1810 REM DRAW PUZZLE
1820 FOR I=1 TO 4:FOR J=1 TO 4
1830 XA=16*(J-1)+4:YA=16*(I-1)+4
1840 GET(XA,YA)-(XA+40,YA+40),A,G
1850 NEXT J,I
1860 RETURN
```

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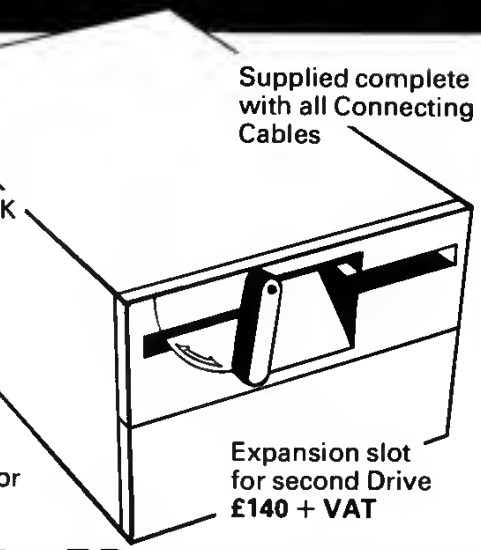
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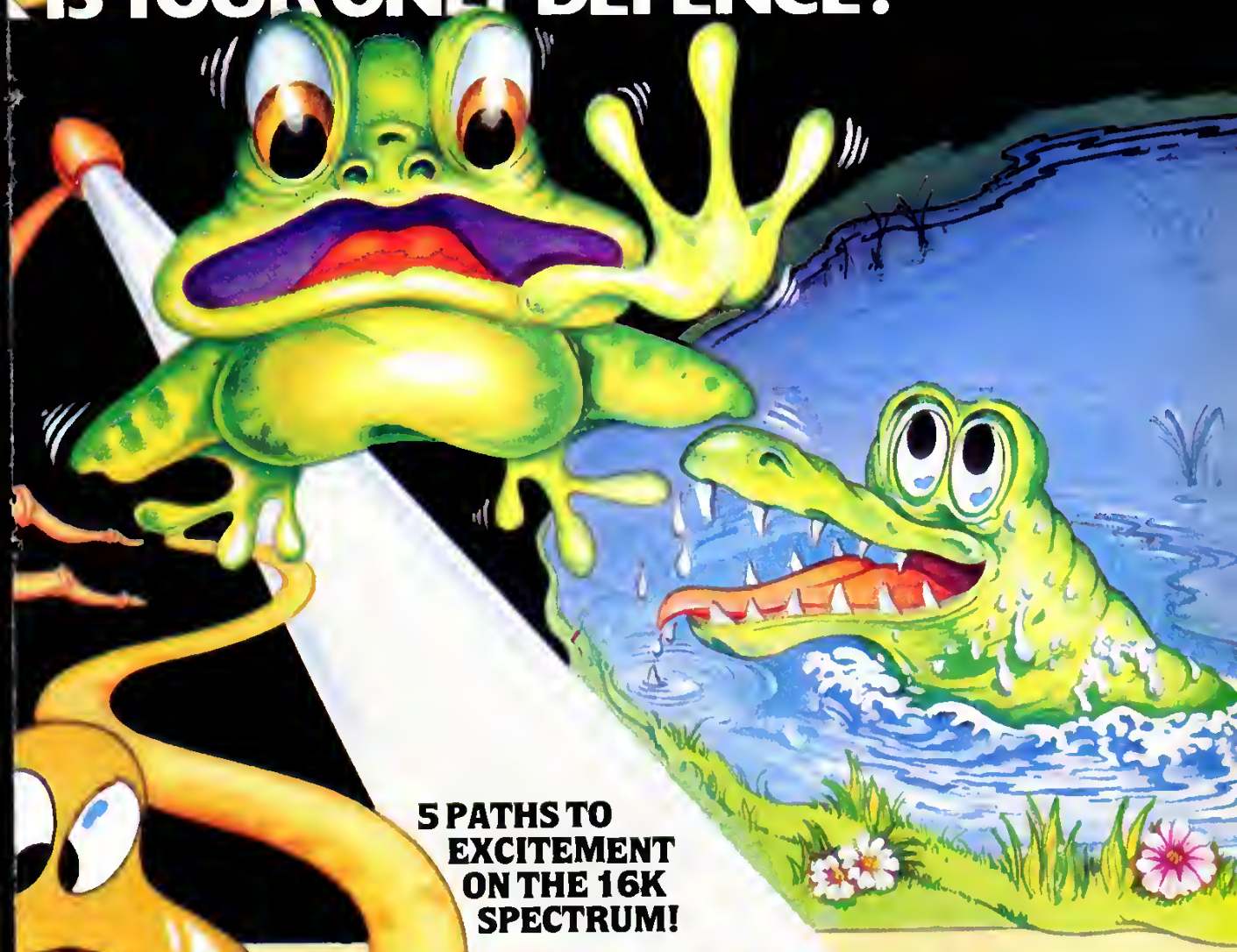
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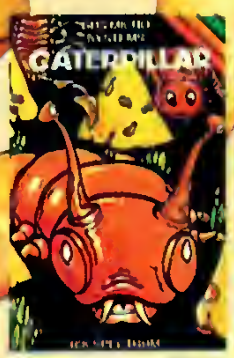
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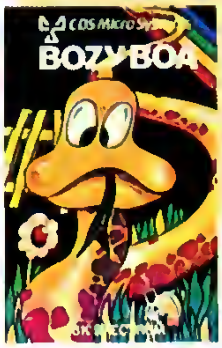
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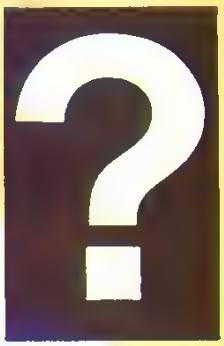
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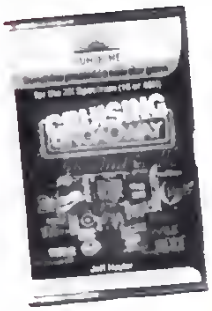
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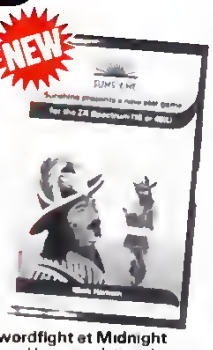
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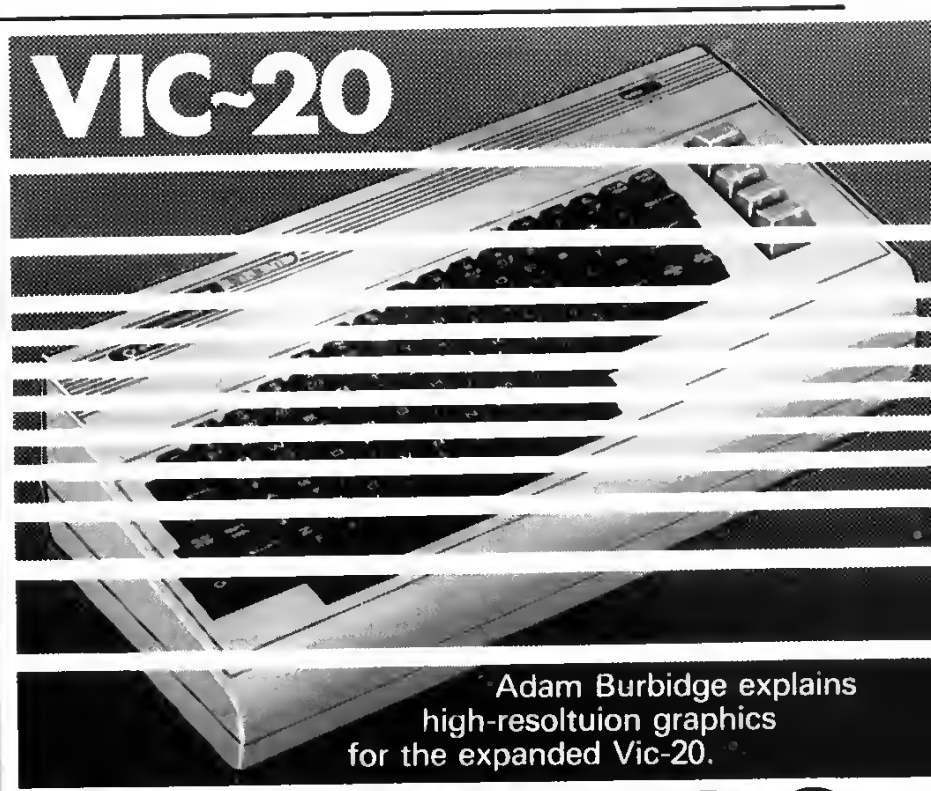
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Adam Burbidge explains high-resoltuion graphics for the expanded Vic-20.

GRAPHICS

HIGH-RESOLUTION graphics on the Vic are an obscure subject to many users and nobody seems to be able to use them to any effect. This may be because there is a well-circulated myth that high-resolution plotting is impossible without the super expander cartridge. This is true for those of you with unexpanded Vics, because there is no user-RAM left available after the high-resolution screen is initialised and the plotting routines are installed.

However, if you have a Vic with 8K expansion RAM, it is possible to use high-resolution graphics effectively. At power-up, your Vic displays the message 11,775 Bytes Free, which if you subtract the 3.5K needed for the graphics screen, still leaves you with a nice big lump of something like 8K of free RAM.

The theory behind the use of high-resolution graphics is simple — the practice is not. This is because the whole of the memory map for Basic storage etc., is rearranged.

As all the RAM before 8192, and after 15872 is used for graphics, and routines, the Basic user-space must be reallocated to between these addresses. This can be done by entering this line:

```
POKE 641,0: POKE 642,32: POKE 643,0. POKE 644,62: SYS 64824
```

Do not worry, the Vic was supposed to do a cold start. As the more observant of you will have noticed, you have lost 4K of RAM. The power up message should now read:

```
7679 BYTES FREE
```

or something near this figure.

What has happened is that the top and bottom of user RAM locations have been changed in order to stop the graphics screen overwriting your Basic program.

For the more technically minded, the high-resolution screen has to be stored at 4096, as this is the only place at which the VIC — Video Interface Chip can access it.

Now that Basic has been relocated you can load the graphics routines which you must have previously saved. Programming in Basic or assembler code can now be carried out in the normal way.

The high-resolution graphics on the Vic work by means of the definable-character facility with the character definitions stored in the address 4096 to 7650, or thereabouts.

However, the Vic only has 256 user-available definable characters and there are 506 screen locations. Therefore, a function called double height characters mode must be used. This sets the character definition grid of 8 by 8 to a double height 8 by 16 matrix. This is done by altering the contents of the VIC chip register at 36867.

Demo 1

```
10AC=5
20POKE 36867,20
30 POKE 36878,16*AC
40 POKE 36879,8
50SYS 16282
60POKE 864,10:SYS16048
70POKE 835,4
80FOR Y=0 TO PI*2 STEP 0.1
90POKE 833,COS(Y)*60+70
100POKE 832,SIN(Y)*60+70
110SYS 15904
120NEXT
130WAIT 197,192,64
```

Now that double-height characters are installed we can set up the screen as follows:

```
character numbers
0  10  . .  210
▼   ▼       ▼
9  19 . . . .219
```

But, as the screen starts at 4096 it must also be relocated back to 7680. This is done by a small part of the set-up machine-code routine. The entire character set is set to blanks and the high-resoltuion screen is set up.

To calculate which byte to Poke with the newly plotted point, we need several equations. The byte to be Poked is calculated by:

```
Byte = 4096 + 16*(INT(X/8)*10 + INT(Y/16)) +
((Y/16)-INT(Y/16))*16
```

The bit to be changed can be calculated by:

```
Bit = 7-((X/8)-INT(X/8))*8
```

When the bit to be changed has been calculated, then a single bit mask will be calculated. This is a binary number with only one bit set, ie:

```
1   — 00000001
2   — 00000010
4   — 00000100
8   — 00001000
16  — 00010000
32  — 00100000
64  — 01000000
128 — 10000000
Bit No. — 76543210
```

In order to set a point, the bit mask is logically Ored with the contents of the byte being changed. This is then repoked back into the byte.

In order to reset a point, the bit mask is logically EOred — exclusively Ored — with 255, and then Anded with the contents of the byte.

For example let the contents of the byte to be changed be 10110101. To set bit 3:

```
  10110101
OR 00001000
  --------
  10111101
```

To reset Bit 0:

```
  00000001
EOR 11111111
  --------
  11111110
AND 10110101
  --------
  10110100
```

Multi-colour mode is a state in which the VIC chip will recognise four seperate coloured points. This is, however, impossible with only one bit as we have used up until now, so we have to use pairs of bits. Unfortunately this means sacrificing half of our current resolution.

You can think of multi-colour mode bytes as blocks of four pairs of two bits each, like this:

```
00 00 00 00
```

As you can see, we now have four possible types of point:

```
00, 01, 10, 11
```

These represent the following colours:

```
00 — screen colour*
01 — character colour
10 — Border colour*
11 — Auxiliary colour
```

Asterisk, * indicates that these depend on the contents of 36879.

(continued on next page)

(continued from previous page)

A point set to the screen colour, is invisible, and thus equivalent to a reset point.

The character colour can be set by Poking 864 with the colour required, and called the Clear routine, by typing:

SYS 16048

To use multicolour mode, the colour is Poked as normal, except 8 is added to the value. For example, to clear the screen white:

POKE 864,9:SYS 16048

This is because bit 3 of the character memory byte indicates whether the corresponding screen byte is multi-coloured, or normal.

To use the Basic loader program simply type in the appropriate program and then Save it onto tape or disc. It can then be loaded and run as a normal Basic program after you have typed in the Pokes in figure 1.

This program will destroy itself when run, so Save it before you run it for the first time. Also, as lengthy conversions are carried out, the program takes several minutes to run.

To demonstrate this, set up the routines in memory and type in the program — Demo 1. Run this, and a circle should be drawn in the colour set by the variable AC, on a black background.

There are three visible colours available with which to plot; these are border, characteer, and auxiliary colour. They are set up as follows:

Border colour is set by Poking 36879 with the screen colour. To get cyan border on a red screen we must Poke 36879 with 32+8+3=43. Thus we have eight possible border colours.

Character colour is normally the colour of the print on the screen, but can easily be changed by using the standard clear routine included at 16048. As multi-colour mode is used, we must add 8 to the value of the colour we want. For example, to make the character colour green, Poke 864,13 and SYS 16048 which is the Clear routine.

Auxiliary colour is the most versatile plot colour as it has 16 different variations. To set this, we Poke 36878 with 16* the colour.

For example, to set the auxiliary colour to pink, Poke 36867,160 (10*16).

Colour code	*Colour*
0	black
1	white
2	red
3	cyan
4	purple (magenta)
5	green
6	blue
7	yellow
8	orange
9	pale orange
10	pink
11	pale cyan
12	pale purple
13	pale green
14	pale blue
15	buff

Colour codes

Call address	*Routine*
16282	Setup
16080	Plotcalc
16048	Clear (colour in 864)
16016	Set*
15984	Reset*
15904	Colplot* (colour in 835)

* = x in 832, Y = 833

Figure 1. Loading and running the programs: First, Poke 641,0:Poke 642,32:Poke 643,0:Poke 644,62:sys 64824 then load Basic loader. Next Run and then load "DEMO-1" and Run.

Basic loader program.

```
1 B$="0123456789ABCDEF"
10 FORZ=15904TO16383
20 READA$
30 A1$=LEFT$(A$,1) A2$=RIGHT$(A$,1)
40 FORT=0TO16
50 X$=M1D$(B$,T+1,1)
60 IFX$=A1$THENA1=T
70 IFX$=A2$THENA2=T
80 NEXTT
90 POKEZ,A1*16+A2
95 NEXTZ
100 REM DATA
110 DATAAD,40,03,29,FE,0D,40,03,AE,43,03,E0,00,D0,09,20,70,3E,EE,41,03,20,70,3E
,E0,01,D0
120 DATA09,20,70,3E,EE,40,03,20,90,3E,E0,03,D0,09,20,90,3E,EE,40,03,20,70,3E,E0
,04,D0,09
130 DATA20,90,3E,EE,40,03,20,90,3E,60,00,FF,00,FF,00,FF,20,FF,00,FE,00,FF,00,FF
,00,FB,20
140 DATAD0,3E,0E,3C,03,49,FF,2D,3C,03,AE,3E,03,AC,3F,03,0E,00,3E,8C,89,3E,0D,AF
,12,60,00
150 DATA00,00,00,00,20,D0,3E,8E,3C,03,0D,3C,03,AE,3E,03,AC,3F,03,8E,A6,3E,0C,A7
,3E,0D,AF
160 DATA12,60,00,00,80,00,00,00,00,AD,60,03,A2,00,9D,00,96,E0,D0,FA,9D,00,97,E0
,D0,FA,60
170 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,AD,40,03,A0,00,C9,09,10,05,A9
,00,48,90
180 DATA17,30,E9,00,C8,C9,00,B0,F0,EA,8C,3C,03,90,A0,09,6D,3C,03,00,D0,FA,40,EA
,AD,41,03
190 DATAC9,10,30,0A,A0,00,30,C8,E9,10,C9,10,10,F0,60,0D,50,03,90,6D,50,03,0D,50
,03,AD,41
200 DATA03,A0,00,E9,10,C0,C9,10,B0,F9,0D,42,03,A9,10,0D,3F,03,A9,00,8D,3E,03,A0
,00,A2,10
210 DATAAD,3E,03,10,6D,50,03,90,03,EE,3F,03,CA,D0,F4,10,6D,42,03,90,03,EE,3F,03
,0D,3E,03
220 DATAAD,40,03,10,29,07,EA,0D,3D,03,A9,07,30,ED,3D,03,0D,3C,03,EA,AE,3C,03,A9
,01,E0,00
230 DATAF0,05,10,0A,CA,D0,FA,AE,3F,03,8E,79,3F,AE,3E,03,0E,70,3F,AE,AF,12,60,00
,00,00,00
240 DATA00,00,80,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
,80,00,C0
250 DATA20,EC,3F,AD,03,90,09,01,0D,03,90,A9,FC,0D,05,90,A9,00,05,01,A9,10,85,02
,A9,00,A0
260 DATA00,91,01,C0,C0,FF,D0,F9,91,01,A0,00,A6,02,E0,06,02,E0,1E,D0,EC,A9,00,0D
,3C,03,A2
270 DATA00,A0,00,9D,00,1E,10,69,0A,C0,E0,C0,16,D0,F4,EE,3C,03,AD,3C,03,A0,00,E0
,DC,D0,E0
200 DATA60,AD,02,90,09,80,0D,02,90,A9,1E,8D,88,02,A5,93,20,D2,FF,60,02
```

The purpose of Setup is to set up the high-resolution screen ready for plotting. There are no parameters. Call address: 16282.

This will clear the screen, and set up high-resolution mode. Several lines of jibberish will remain at the bottom of the screen — these may be removed by typing:

POKE 36867,20

The purpose of Plotcalc is to calculate the part of memory, and a single bit mask, in which a point occurs. Parameters: X position is in 832 and Y position is in 833. Call Address: 16080.

If this routine is called on its own, then nothing will seem to occur. This is because Plotcalc only sets up the address and bit mask for other routines. However, it is useful in itself, as it consists of four seperate parts: Charcalc, Rowcalc, Bytecalc and Bitcalc. These routines use parts of memory for variable storage, as follows:

Location	Name	Function
848	Char	Stores the character number within which the current point falls.
834	Row	The current row in the character in which the point lies
830-831		LSB and MSB respectively of the byte which was calculated as the one in which the current point lies.

With some cunning programming, it could easily be rigged so that the character colour — or normal colour if plotting is not in multi-colour mode — is selectively set for each point plotted. The big snag with this is that any other points within the boundary of the character colour changed will also change colour. Therefore only one character colour is possible per group of 16 by 8 points — the double-height character size.

The purpose of Clear is to set the screen character colours to a specified choice. The character colour is in 864. Call Address: 16048.

This does not affect the contents of the actual high-resolution screen so this routine can be called during a display without ruining the picture on the screen.

The purpose of Set is to set a high-resolution point — not multi-colour. Parameters: X is in 832 and Y is in 833. Call Address: 16016.

This routine will call Plotcalc and then set the point calculated from this address.

Reset's purpose is to clear a high-resolution point — not multi-colour. Parameters: X is in 832 and Y is in 833. Call Address: 15984.

This routine also calls Plotcalc and then resets the point calculated from this address.

Colplot sets a multi-colour mode-point. Parameters: X is in 832 and Y is in 833. Colour is in 834. Call Address:15904.

The set and reset routines are called, according to the colour of point to be set, as detailed in the theory section.

When using graphics, the following procedure must always be observed:

- Call the Set-up routine.
- Set the character colour with the Clear routine.
- Set the screen and border colour, by Poking 36879.
- Set the auxiliary colour by Poking 36878.

Plotting can then be done as normal. ■

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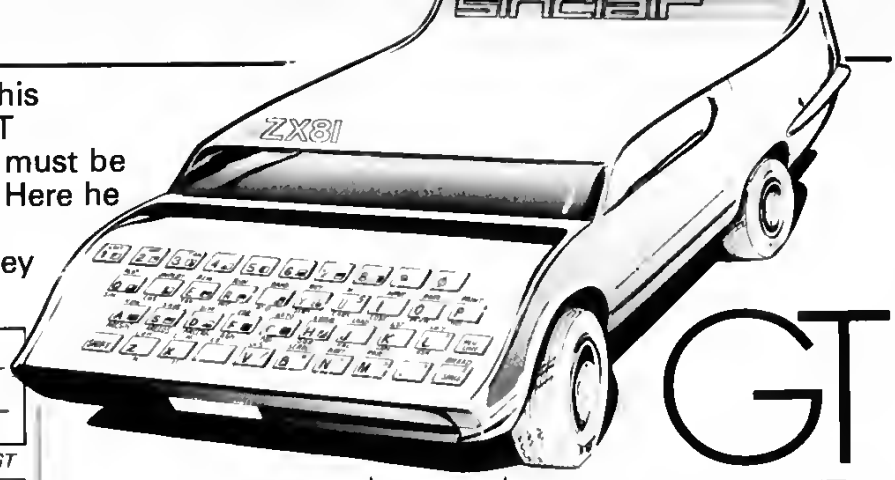
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ZXGT COMPILER



David Threlfall continues his insight into how the ZXGT compiler works and what must be considered in the design. Here he looks at the compiler's shortcomings and how they have been overcome.

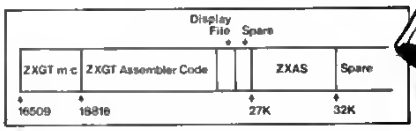


Figure 1a: Memory map during work on ZXGT

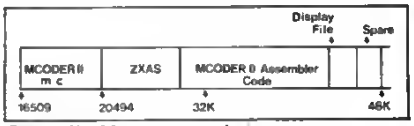


Figure 1b: Memory map during work on MCoder II

A FEW MONTHS after ZXGT had been put on the market as MCoder a few of its shortcomings became apparent. As it stood it worked extremely well, was very fast and far exceeded its original specification, but there are several areas where improvements would be welcome. Problem areas include;

■ No strings — this can be circumvented but string handling would make more a much more versatile compiler.

■ Only 25 variables — programs written for ZXGT were getting larger and this restriction was proving a major handicap to writing understandable code. Multi-character names were necessary, not even two-character names as on the Pet could be considered.

■ Only one numeric array — the array was added as an afterthought primarily to help fulfil the role of data logger on scientific experiments. A full 26 arrays, even if one dimensional, would be very useful.

■ Printing was not *à la* Basic — each number was printed with a leading space and "," did not tabulate.

■ Lprint was not supported.

■ No Boolean algebra at all — a little would be useful.

■ Input was totally non-standard, it appears on the main screen not on the input area and there is no rubout. Input at the bottom of the screen with the ability to correct mistakes was necessary.

■ At about 56 times faster than Basic it was not slow but work on the Spectrum version had shown that more speed was possible — the final version is almost 70 times faster than Basic.

■ Brackets are necessary except in Let — this is compatible with Basic but annoying.

■ Last but still relevant was size. The original ZXGT had been aimed at 2K bytes and only just ran over but most users gave the impression that to obtain the items above they would sacrifice a little more space and longer loading time. 4K was felt to be optimum if all these features could be added.

■ Floating point. Slight consideration was given to full floating-point arithmetic. However, work with Microsoft's compiler on a larger machine had shown that a speed up of only five or so could be expected particularly as Sinclair's ROM routines are very slow. Put another way the balance between interpretation and evaluation is heavily on evaluating. For this reason primarily it was decided to stay with integer arithmetic on all the compilers for Sinclair computers.

Readers may wonder why these features were not implemented in ZXGT. ZXGT was not written directly in machine code but in assembler, a listing of which has been appearing in parallel with this text. It is hard

(continued on next page)

```
The Sinclair functions are
examined here and code
appropriate to each is
generated.
PEEK ?
 L161:   CP 211
         Jk NZ,L161
         CALL L180
         LD HL,46F7E
         CALL L36
         LD HL,00026
         JP L36
USR ?
 L161:   CP 212
         JR NZ,L152
         CALL L180
         LD HL,L163
         JP L39
 L163:   LD BC,L160
         PUSH BC
         PUSH HL
         RET
 L160:   LD H,B
         LD L,C
         RET
CODE INKEY$ ?
 L162:   CP 196
         JP NZ,L160
         CALL L240
         CP 45
         JP NZ,L252
         LD HL,L53
         CALL L39
         LD A,38
         LD HL,46F00
         JP L30
RND ?
 L160:   CP 64
         JP NZ,L172
         LD HL,L117
         JP L39
ABS ?
 L172:   CP 210
         JR NZ,L201
         CALL L180
         LD HL,47CC8
         CALL L36
         LD A,196
         LD HL,L231
         JP L38
                                  10
INT ?
 L201:   CP 207
         JP NZ,L252
         JP L180
 L244:   CALL L180
Get a pair of arguments and
generate the code
    ld hl,nnnn or ld hl,(nnnn)
    push hl
    ld hl,nnnn or ld hl,(nnnn)
    pop de
         CALL L240
 L246:   PUSH AF
         LD A,229
         CALL L241
         CALL L180
         LD A,209
         CALL L241
         POP AF
         RET
Work out what the next thing is.
Is it a variable, a number or a
function?
 L180:   CALL L240
 L182:   CP 22
         PUSH AF
         CALL Z,L240
         CP 16
         JR Z,L218
         CP 64
         JR NC,L97
         CP 38
         CALL NC,L245
         CALL C,L86
 L90:    POP AF
         CALL Z,L238
         RET
 L97:    CALL L16
         JR L90
 L218:   CALL L200
         JR L90
Generate negation code.
 L238:   LD HL,L231
         JR L39
Actually do the negation.
 L231:   LD A,H
         CPL
         LD H,A
         LD A,L
         CPL
         LD L,A
         INC HL
         RET
                                  11
Get variable then code is
generated for ld hl,(nnnn).
 L245:   CALL L37
         CP 180
         JP Z,L234
         LD A,42
         JP L38
Get integer then code generated
for ld hl,nnnn.
 L86:    CALL L81
         LD A,33
         JR L38
STOP statement seen
 L118:   CALL L96
         POP HL
         LD BC,(16507)
         RET
CLS statement seen. Generate a
call to the ROM.
 L52:    LD HL,6A2A
         JR L39
SCROLL statement seen. Generate
a call to the scroll routine.
 L130:   LD HL,L131
         JR L39
A routine to save either HL as
code, HL and A as code or to
generate a call to the number
presently in HL.
 L39:    LD A,205
 L38:    CALL L241
 L36:    LD A,L
         CALL L241
         LD A,H
         JP L241
POKE , get the two arguments and
make sure that a comma seperates
them.
 L141:   CALL L244
         CALL L107
         LD HL,473E8
         JR L36
Check that the char in A is a
comma, if not error.
 L107:   CP 26
         JP NZ,L252
         RET
                                  12
FOR statement seen. Generate
code to load the variable with
the first number and keep the
second number incremented by one
in the next location.
 L108:   CALL L240
         CALL L37
         PUSH HL
         PUSH HL
         CALL L240 ,
         CALL L244
         LD A,35
         CALL L241
         LD HL,853ED
         CALL L36
         POP HL
         CALL L36
         LD A,34
         INC HL
         INC HL
         CALL L38
         POP HL
         LD DE,(16507)
         CALL L170
         RET
NEXT statement. Find the
variable name and generate code
to increment it and test if am
have reached the end. See Text.
 L181:   CALL L240
         CALL L37
         PUSH HL
         PUSH HL
         LD A,42
         CALL L30
         LD HL,42223
         CALL L36
         POP HL
         CALL L36
         INC HL
         INC HL
         LD A,237
         CALL L241
         LD A,91
         CALL L38
         LD A,167
         LD HL,852ED
```

(listing continued on next page)

(listing continued from previous page)

```
            CALL L30
            LD A,250
            POP HL
            CALL L171
            EX DE,HL
            CALL L30
            RET

                                    13
Get  a  number  from  the  code
skipping over the floating point
form which follows it.
 L81:   LD HL,0
        JR L83
 L85:   CALL L240
        CP 124
        JR Z,L84
        PUSH AF
        LD DE,10
        CALL L112
        POP AF
 L83:   CP 38
        JP NC,L252
        CP 28
        JP C,L252
        SUB 28
        LD B,0
        LD C,A
        ADD HL,BC
        JR L85
 L84:   PUSH HL
        LD HL,(16406)
        LD DE,5
        ADD HL,DE
        LD (16406),HL
        POP HL
        RET
INPUT   statement.    Find   the
veriable and generate a call  to
read  the keyboard and then code
to  put  the  result  in  the  slot
reserved for thet veriable.
 L75:   LD HL,L88
        CALL L39
        CALL L240
        CALL L37
        JP L185
PLOT statement. Find the pair of
arguments  and  then  generate  a
cell to the Plotting routine.
 L60:   LD A,178
 L61:   PUSH AF
        CALL L244
        CALL L187
        LD HL,44548
        CALL L36
        LD A,13E
        CALL L241
        POP AF
        CALL L241
        LD A,632
        LD HL,64030
        CALL L38
        LD HL,L113
        JP L39

                                    14
UNPLOT statement. Much like PLOT
but  with  a  different  argument
generated.
 L65:   LD A,640
        JR L61
RAND statement. Gets number and
puts it into location 16436.
 L31:   LD A,42
        LD HL,16436
        CALL L38
        LD A,34
        LD HL,16434
        JP L38
IF tests start here. Arrive with
DE=first argument, HL=second and
A=operation. Result is carry set
if condition true.
 L180:  CP 221
        JR Z,L182
        CP 20
        JR Z,L184
        RRA
        JR NC,L191
        EX DE,HL
 L181:  RLA
        AND A
        SBC HL,DE
        SCF
        RET M
        RLA
        RET NC
```

(listing continued on page 123)

(continued from previous page)

to write very compact machine code mainly because changes and corrections are nearly impossible so space is always left just in case.

However, it is impossible to fit an assembler, the target code and the source for more than 1.5K of machine code in a 16K machine. That is why the code was written in two longish sections — figure 1a. This left two options — write the code in more than two sections — two were hard to manipulate, three or more would be devilish — or bootstrap from Basic.

The concept of bootstrapping is to write a small compiler with features that allow you to write a larger one. At least one Algol compiler has been written that way. Just a kernel of machine code is necessary to get started and this already existed in ZXGT.

This route was avoided since the code generated by ZXGT is 16-bit integer and therefore would not be suited to the mainly eight-bit character handling of a compiler. Perhaps somone would like to write an eight-bit version of ZXGT — it would be even faster.

Now, you are probably asking why I did not buy a 32K or larger memory pack. The answer is that I had one but that ZXAS — the assembler I had — sat in the 27 to 32K slot so stopping Basic from crossing the 32K word boundary. For those who do not already know, it is quite permissible for Basic code — not just variables and arrays — to cross this boundary but at no time must the display file straddle the line, either side is equally alright. Also, you cannot run machine code which sits above 32K.

Salvation finally came when DCoder arrived on the market. DCoder is a disassembler but more important it is a relocator so it was possible to relocate ZXAS to sit above the compiler machine code — figure 1b.

Relocatable code is code which may be put and run anywhere in the machine. It is easy to write relocatable sub-routines but whole programs are harder. Suffice to say that neither ZXAS or ZXGT are relocatable.

So a relocator is a smart disassembler which can spot which jumps and calls are to within the code to be moved and change them appropriate to the new location. This does not make the relocated code relocatable but merely changes where it will run. The twist to this story is that DCoder was written independently by someone using MCoder — alias ZXGT.

The third major limitation was the Sinclair tape interface. I have rarely had any trouble with this but by the time MCoder II was completed 32K bytes of code had to be run back in each time the machine crashed. With the standard tape interface that takes about 15 minutes. This time the remedy was QSave which records 32K bytes in a little under one minute onto a standard tape recorder.

The final piece in the jigsaw, which arrived when MCoder II was nearly complete, was Ian Logan's ROM disassembly for the ZX-81. This allowed several new features to be added by using ROM routines to save space. ROM routines were only used where time was not critical eg . in Epi'nt. It also explained some of the clever but slow features of Sinclair's Basic.

In this section problem areas will be discussed in detail.

■ Strings: The major difficulty with strings was to avoid garbage collection when the string was lengthened or shortened. Eventually this was solved by decreeing that all strings would have a maximum length of 32 bytes. This length is held in a location that is known to the user so that it may be Poked from Basic.

The value is reset to 32 when the compiled program is run and must be Poked from your program. By this means the maximum length for individual strings can be set as the string is used for the first time. Thereafter the length of that string cannot be increased beyond that limit. There are no string arrays.

All strings — and numeric arrays for that matter — are allocated space at run-time and so sizes need not be preset. These strings/arrays are stored above Stkend. Consider this short program:

```
1 INPUT N
2 DIM A(N)
3 LET B$="QWERTYUIOP"
4 LET C$="BROWN FOX"
5 DIM X(N+N)
```

The program would prompt for N, allocate the array A — 2*N bytes to be zeroed — allocate B$ and C$ and finally allocate the array X of length 2N. Note the use of addition rather than multiplication to form 2N. Multiplication takes 10 times longer than addition and division 50 times longer. The result is the memory map shown in figure 2.

To concatenate strings, and that includes CHR$, INKEY$ or "string", it is necessary to form the new string elsewhere than its final resting place in case a string appears both on the left and right hand side of the assignment. For example:

```
LET A$ = A$(1 TO 3) + A$(6) + CHR$
128 + B$ + "*"
```

results in the new A$ being built above Last —

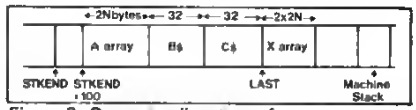


Figure 2: Dynamic allocation of space.

see figure 3 — and then locations Last to End are copied into A$. The length of the string is simply the number of bytes between Last and End.

Printing strings is a similar process except that the final copy is to the screen. A more difficult task is to compare two strings, for example:

```
IF A$ <> B$ THEN PRINT "NOT EQUAL"
```

A copy of A$ is made above Last — which is reset first — and a copy of B$ is made above that. Each is terminated with the code 255. With HL pointing to A$ and BC to B$, incrementing and comparing and using the results flags it is possible to do all six standard comparisons with one short routine.

■ Full variable names: Sinclair Basic is rare in allowing variable names of any length which may contain spaces if desired. Apart from disallowing spaces this is fully implemented in MCoder II. The variable names are stored as shown in figure 4. The names are entered downwards from just below the machine stack — actually 256 bytes clear of RAMtop — and the last letter is stored in inverse video, ie., bit seven is set.

For strings the names are considered to be A$ to Z$ and for arrays A< to Z< thereby differentiating between the three sorts of variable. An example might be to store the names Fred, A$, One and an array C, these would be stored down from just below the stack thus:

```
F
R
E
Inverse D
A
Inverse $
O
N
Inverse E
C
Inverse <
0
```

The zero on the bottom marks the end of the list. There can only be 255 variables as a single byte is used to store the number of variables. A careful note should be kept during compilation of the maximum number of concurrent variables together so that space may be reserved for them at the end of the compiled code.

In Basic the command Clear removes all the

(continued on page 123)

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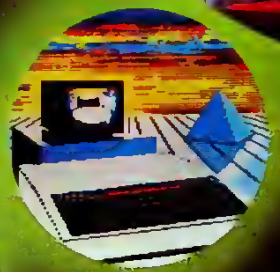




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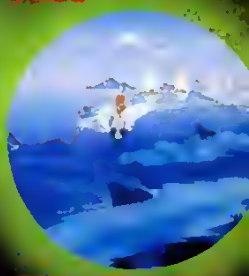


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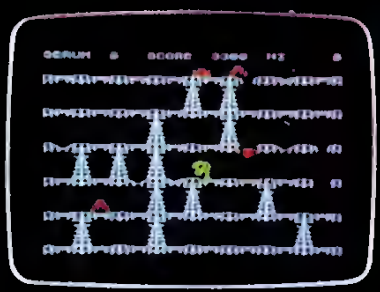
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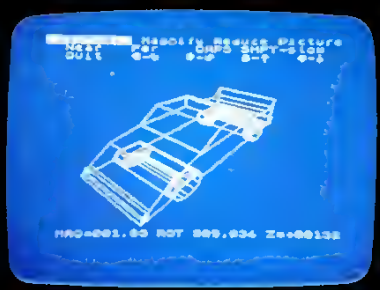
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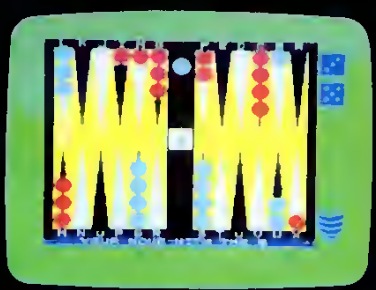
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(continued from page 120)

variables, but in MCoder the command merely zeroes all the variables used in the program. Zeroing the locations reserved for a string variable actually zeroes the pointer to the string implying that it has not yet been allocated.

■ Numeric arrays: As the DIM statement for an array is encountered by the compiler, code is generated to load the HL register pair with the length of the array — always one dimensional — and a call is generated to the "allocate space and zero" routine. This generates and stores a pointer to where the array is to be put and then zeroes the array as follows:

```
LD HL, where array is to be put (=LAST)
LD, BC, length of array*2
LD D, H
LD E,L
INC DE
LD (HL),0
LDIR
LD (LAST),DE
```

If the array already exists then the old one is forgotten and a new one created. This failure to collect old, unused space can be wasteful but is not considered too detrimental.

Array elements are accessed by calculating the index, doubling it — two bytes per element — and adding this number to the base address of the array. No array bound checking is done as the code is assumed to be fully tested under Basic.

■ Printing to the screen: To attain the same result as Basic is really only a matter of attention to detail. However, the Tab command may be of some interest. Sinclair stores the column number where printing is to take place next but stores it backwards. The actual column number stored is 33 — the number the user inputs. For example Tab 5 makes the system variable S_POSN (16441) take the value 28 and Tab 25 yields the value 8.

■ Printing to the ZX printer: If printing to the screen is clear, but perverse, consider Lprint. The printer buffer is in locations 16444 to 16476. Tab 5 makes PR_CC take the value 69 and Tab 25 makes it 89, these numbers being the lower byte of the address in the buffer. Otherwise the change from Print to Lprint commands requires only that bit one of location 16385 be set and then Sinclair's routines for Print, Tab, At etc may be used.

■ Boolean operations: Only two Boolean operations have been made available in MCoder II:

B AND C which is true if B and C are non zero
B OR C which is true if either B or C or both are non zero

These are only implemented in the If statement using routines for Or and And which are called with HL containing one 16 bit argument and DE the other. They return a set carry flag if the result is true.

```
AND.  LD A,H      ;test if
      OR L        ;HL is zero
      RET Z       ;return if it is

      LD A,D      ;now do DE
      OR E
      RET Z
      SCF         ;set carry flag
      RET         ;return
OR:   LD A,H      ;test if HL zero
      OR L
      JR Z,+2     ;jump on if it is
      SCF         ;HL non zero, set carry
      RET
      LD A,D
      OR E
      RET Z       ;both HL and DE zero
      SCF
      RET
```

■ Input: This had to be completely rewritten to be like Basic. For simplicity of coding input is limited to 31 characters plus the prompt so that it all fits on one line. This avoids the problem of compressing the display file. Invalid characters will not print, incorrect ones may be rubbed out, but you cannot step over characters using the cursors.

The screen is used as the input buffer and a string input is copied directly to the space reserved for the variable. The length can be ascertained from the position of the cursor. At the end the buffer is cleared using part of the array zeroing routine described above.

■ Speed: In ZXGT the particular If test to be carried out was decided at run-time. This resulted in very short code for the six functions. In MCoder II code is generated at compile time. As before HL and DE contain the two operands in the general form.

IF operand1 operator operand2 THEN

and the code generated is:

```
LD HL,operand1    ;this may be the result of an
                   evaluation
PUSH HL
LD HL,operand2
PDP DE
AND A             ;clear carry flag
SBC, HL, DE       ;subtract the two operands
                   from each other
JP 'flag', NEXT
                  ;code to be executed if the
                   condition
                  ;is true
NEXT:             ;next statement after IF
```

where 'flag' depends on the operator. For example <> requires the use of the zero flag. This results in considerably quicker code than in ZXGT, often by almost 50 per cent.

■ Brackets: Originally an arithmetic expression was terminated either by the end of line character — 118 — or by a right bracket. The change required to evaluate an expression where brackets are not necessary — ie, like Basic — turned out to be very easy but needed the logic to be stood on its head. The expression is now not terminated by the four operators +,—,/,* and everything else means that the end has been reached, be it with a comma, semicolon, bracket etc.

Sinclair makes a distinction between the way that various functions decide where their arguments stop. For instance Peek 16388+1 means (Peek 16388)+1 not Peek (16388+1) but Poke 16388+1,n means the same as Poke 16389,n.

It seemed as if all the functions just picked up the next item, enclosed in brackets if necessary, while statements such as Poke, Plot etc., took expressions treating the comma or end of line as terminator. However, all was not so simple as Tab, which seems to be a function, takes the whole expression up to the next delimiter eg., Tab 5+3 means Tab 8.

■ Size: The final size of MCoder II at 3980 bytes is considerably larger than ZXGT/MCoder showing how expensive in space the refinements proved but it is a much easier program to use and its versatility is greatly enhanced.

I hope that this short series has given some insights into the way that a compiler works and what it is necessary to consider in the design.

ZXGT is marketed by Personal Software Services, 452 Stoney Stanton Road, Coventry CV6 5DG. ■

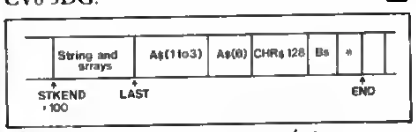


Figure 3: Forming a concatenated string.

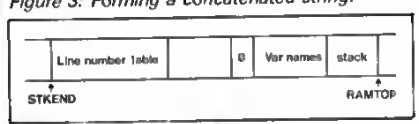


Figure 4: Storage of variable names.

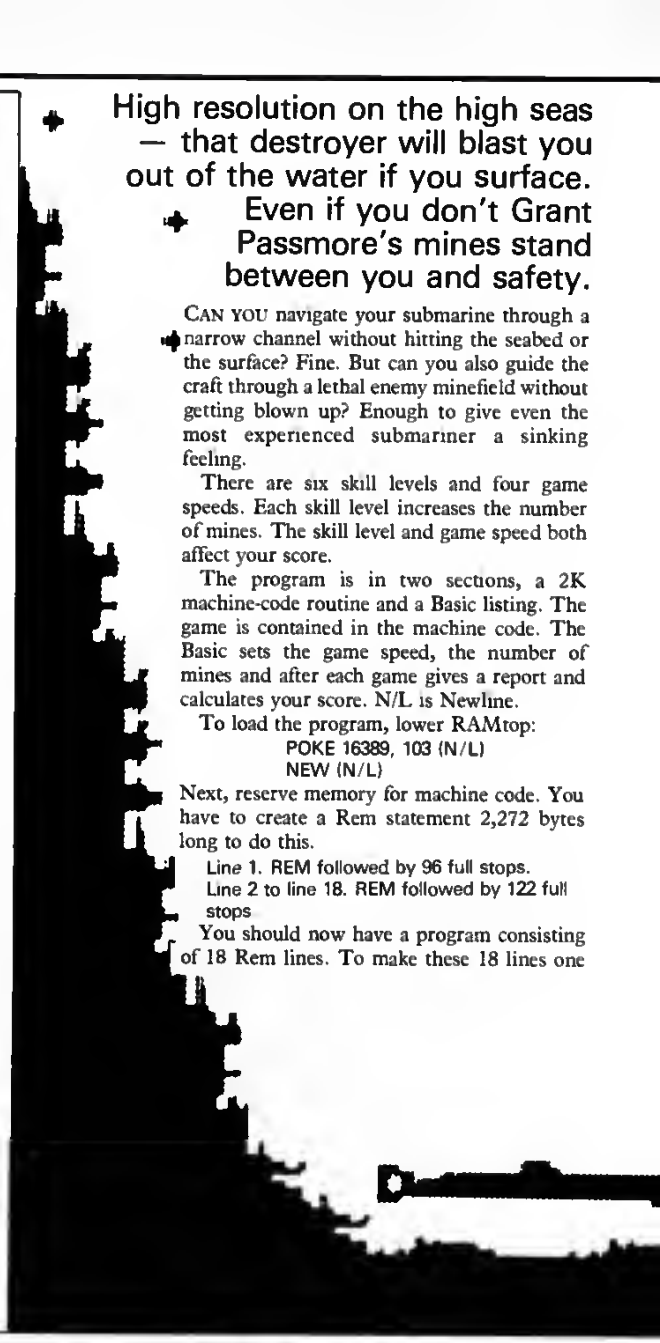
(listing continued from page 120)

```
        JR Lt88
Lt82:   SBC HL,DE
L183:   SCF
        RET NZ
        JR L185
L184:   SBC HL,DE
L188:   SCF
        RET Z
L185:   CCF
        RET
IF statement. Generate code to
get the two operands to be
compared and put operation in A
register. Generate call to " If
tests". On return test carry and
jump to next line of code if its
not set.
 L186:  CALL L244
        LD H,A
        LD L,62
        CALL L36
        LD HL,L188
        CALL L39
        LD HL,(16394)
        INC HL
        CALL L9t
        EX DE,HL
        CALL L171
        EX DE,HL
        LD A,218
        CALL L38
        CALL L240
        CP 222
        JP NZ,L252
        RET
FAST and SLOW ststements.
Because the direct calls to the
ROM moved in the new ROM some of
the ROM code is duplicated here.
 L48:   LD HL,L183
        JP L39
L183:   CALL 0B2E7
        LD HL,64038
        RES 6,(HL)
        RET
L38:    LD HL,L184
        JP L39
L184:   LD HL,64038
        SET 6,(HL)
        JP 6297
Get address of next line. Enter
with HL pointing to the length
of the present line. Return with
HL pointing to the new line.
 L50:   LD C,(HL)
        INC HL
        LD B,(HL)
        ADD HL,BC
        INC HL
        LD A,(16396)
        SBC A,L
        RET NZ
        LD A,(16397)
        SBC A,H
        RET
DIM statement. Make sure
argument is only single
dimensional. The size is ignored
as there is only one array. Note
that the array is not zeroed.
 L236:  CALL L240
        CP 63
        JP NZ,L252
        CALL L188
        XOR A
        RET
                                  16
These last two routines are used
in calculating the location of
an array element. Basically the
subscript is doubled and added
to the contents of STKEND
(16412).
 L233:  CALL L188
        LD HL,64BED
        CALL L36
        LD HL,16412
        CALL L36
        LD HL,6929
        JP L36
L234:   CALL L233
        LD A,0D5
        CALL L24t
        LD HL,Lt7t
        CALL L39
        LD HL,0D1E8
        JP L36
Finally a jump list which links
to the jump list at the start of
the first section. Although
relatively expensive in space
this method is pretty fool proof
if any code is moved.
 Lt5t:  JP 64B8B;PRNT
 L131:  JP 64BB8;SCROLL
 L51:   JP 64BBE;GETK
 L53:   JP 64B91;TESTK
 Ltlt:  JP 64d94;PAUSE
 L112:  JP 64B97;MULT
 L113:  JP 64B9A;PLOT
 Lt14:  JP 64B9D;RSTt0
 L115:  JP 64BA8;0668
 L116:  EX DE,HL
        JP 64BA3;DIV
 L117:  JP 64BA6;RND
 L08:   JP 64BA9;GETNUM
 L187:  JP 64BAC;REM
 L241:  JP 64BAF;SAVE
```

Program 1. The Basic listing.

```
  4 SAVE "SEA NINES"
  5 RAND
  6 CLS
  20 PRINT AT 0,0,"
MINES SEA
                    G.J.P. COM
PUTER  SOFTWARE
  10 LET SC=0
  12 LET SU=0
  15 LET 9$= 000000
  18 LET R$=5$
  20 LET SU=5
  40 PRINT AT 0,3 "SELECT INITIA
L SKILL LEVEL",C$,C$,TAB 7,"1. L
IEUTENANT",TAB 7,"2. LIEUT. COMM
ANDER",TAB 7,"3. COMMANDER",TAB
7,"4. CAPTAIN",TAB 7,"5. COMMODO
RE",TAB 7,"6. ADMIRAL",C$,C$,TAB
 10,"PRESS KEY 1 TO 6"
  60 LET K$=INKEY$
  61 PRINT AT 19,20,"■ TO ■"
  62 FOR F=1 TO 3
  63 NEXT F
  64 PRINT AT 19,20,"1 TO 9"
  66 IF K$="" THEN GOTO 60
  70 IF CODE K$(29 OR CODE K$)34
 THEN GOTO 60
  72 GOSUB 1000
  76 LET R=CODE K$-28
  80 PRINT AT 5,3,"SELECT GAME S
PEED","(1. FAST, TAB 7,"3. AVERA
GE",TAB 15,"4. SLOW)",C$,C$,C$,C$
,TAB 10,"PRESS KEY 1 TO 4"
  81 IF INKEY$<>"" THEN GOTO 81
  82 LET K$=INKEY$
  83 PRINT AT 19,20,"■ TO ■"
  84 FOR F=1 TO 3
  86 NEXT F
  87 PRINT AT 19,20,"1 TO 4"
  89 IF K$="" THEN GOTO 82
  90 IF CODE K$(29 OR CODE K$)32
 THEN GOTO 60
  95 LET S=CODE K$-28
 100 GOSUB 1000
 105 GOSUB 1500
 109 IF T5C=0 THEN GOTO 900
 110 IF T5C=0 THEN PRINT AT 10,1
8-(LEN D$/2),D$,C$,C$,C$,TAB 6,"
YOU HAVE 5 SUBMARINES",C$,C$,TAB
 11,"EACH"
 130 GOSUB 2000
 140 GOSUB 1000
 150 POKE 17624,A+2
 215 POKE 15434,(INT (RND*204))+
2
 220 POKE 16919,(5+2)
 230 LET X=USR 16400
 240 IF R=0*RND<3 THEN GOTO 270
 245 POKE 26929,150
 250 POKE 26962,150
 260 POKE 26995,150
 270 LET X=USR 16433
 275 LET ST=PEEK 16417
 280 IF ST=3 THEN GOTO 500
 281 LET A=A+1
 282 IF A=7 THEN GOTO 330
 284 GOSUB 1500
 285 PRINT AT 6,5,"YOU HAVE ESCA
PED FROM",TAB 5,"THE NINEFIELD",
C$,TAB 5,"GRAINING PROMOTION TO",
TAB 5,D$,C$,C$,C$
 300 GOTO 340
 330 PRINT AT 6,5,"YOU HAVE ESCA
PED FROM",TAB 5,"THE MINEFIELD
ADMIRAL",C$,C$ C$,C$,C$,C$,
 337 LET A=A-1
 340 LET FAC=4
 345 GOSUB 8110
 350 PRINT TAB 5,"YOU SCORED
",TAB 5,"TOTAL SCORE ";R$
 351 GOSUB 8120
 353 GOSUB 1000
 355 IF SU=0 THEN GOTO 5000
 360 GOTO 900
 500 LET PD=PEEK 16092+(256*PEEK
 16093)
 505 LET SU=SU-1
 507 IF SU=0 THEN GOTO 5000
 510 LET FA=INT ((PD-25731)/33)
 520 LET FR=FA+2
 530 IF PD<25761 THEN PRINT AT 0
,15-LEN D$/2),D$,C$,C$,TAB 4,"Y
OU SRDKE SURFACE!",C$,TAB 4,"THE
 FRIGATE  DESTROYED",TAB 4,"YOU
R SUBNARINE  C$ C$,
 532 IF PD<26761 THEN LET FR=3
 535 IF PD<26791 THEN GOTO 650
 539 LET FA=156
 540 IF PEEK (PD+31)<>F OR PEEK
(PD+196)<>F OR PEEK (PD+200)<>F
OR PEEK (PD+168)<>F OR PEEK (PD+
68)<>F OR PEEK (PD+166)<>F THEN
GOTO 600
 550 LET FR=2
 570 PRINT AT 5,15-(LEN D$/2),D$
,C$,C$,TAB 3,"YOU HIT A MINE AT
A",C$,TAB 9,"DEPTH OF ",FR," FAT
HOMS",C$,C$,
 590 GOSUB 650
 600 PRINT AT 8,15-(LEN D$/8),D$
C$,C$,TAB 6,"YOU HIT THE SEABED
AT",C$,TAB 5,"A DEPTH OF ";FR;"
FATHOMS",C$,C$,
 605 LET FAC=1
 650 GOSUB 4000
 660 PRINT TAB 5,C$,"YOU SCORED
",9$,"TAB 5,"TOTAL SCORE ",R$
,C$,TAB 5,"REMAINING VESSELS
,SU
 665 GOSUB 2000
 670 GOSUB 1000
 675 IF SU=0 THEN GOTO 5000
 677 IF R<3 THEN GOTO 900
 680 GOTO 880
 685 PRINT AT 0,5,"PRESENT GAME
SPEED ",R,C$,C$,TAB 5,"DO YOU
WANT TO CHANGE",TAB 5,"THE GAME
 SPEED",R,C$,C$,C$,C$,C$,TAB
10,"PRESS KEY YES OR NO"
 910 LET K$=INKEY$
 915 PRINT AT 19,20,"■ OR ■"
 916 FOR F=1 TO 2
 917 NEXT F
 918 PRINT AT 19,20,"YES OR NO"
 920 IF K$="" THEN GOTO 910
 925 IF K$<>"N" AND K$<>"Y" THEN
GOTO 910
 930 IF K$="N" THEN GOTO 970
 940 IF INKEY$<>"" THEN GOTO 940
 950 GOSUB 1000
 960 GOTO 60
 970 GOSUB 1000
 980 GOTO 200
 999 STOP
1000 PRINT AT 5,0,C$,C$,C$,C$,C$
,C$,C$,C$,C$,C$,C$,C$,C$,C$,C$,C
$,C$
1010 RETURN
1500 IF R=1 THEN LET D$="LIAUTEN
ANT"
1510 IF R=2 THEN LET D$="LIAUTEN
ANT COMMANDRA"
1520 IF R=3 THEN LET D$="COMMAND
ER"
1530 IF R=4 THEN LET D$="CAPTAIN
"
1540 IF R=5 THEN LET D$="COMMODO
RE"
1550 IF R=6 THEN LET D$="ADMIRAL
"
1560 RETURN
2000 GOSUB A270
2010 IF AND(,6 THEN GOTO A000
2020 LET K$=T$(1+((AN-1)*A1) TO
(AN*A1)
2030 LET X=16087
2040 LET G=0 TO 7
2050 LET X=17011
2070 GOSUB 2240
2080 LET K$=T$(200+((AN-1)*8) TO
 200+(AN*8)
2090 LET X=17003
2100 GOTO 2090
2120 GOSUB A270
2130 IF AND(,6 THEN GOTO 2170
2140 LET K$=T$(145+((AN-1)*25) T
O 144+(AN*24)
2150 LET X=17035
2160 GOTO 2190
2170 LET K$=T$(217+((AN-1)*24) T
O 210+(RN*24)
2180 LET X=17059
2190 GOSUB 2240
2200 LET K$=T$(310+((AN-1)*8) TO
 315+(RN*8)
2210 LET X=17002
2220 GOTO 2290
2240 FOR F=1 TO 24
2250 POKE (X+F),CODE K$(F)
2260 NEXT F
2270 LET AN=(INT (AND*3))+1
2280 RETURN
2290 FOR F=1 TO 9
2300 POKE (X+F),CODE K$(F)
2310 NEXT F
2320 RETURN
4000 LET 9C=INT (R*(5-6)*(100/FA
)+FRC)*3
4005 IF FRC(>4 THEN GOTO 4012
4010 LET 9C=INT (R*(6-6)*FRC)*24
4012 LET T5C=T5C+5C
4015 LET 5$=0$(3 TO 5-(LEN (STR$
 5C)))+STR$ 5C
4020 LET M$=0$(1 TO 6-(LEN (STR$
 T5C)))+STR$ T5C
4030 RETURN
5000 PRINT AT 7,10,C$,C$,TAB 9,"
ALL SUBMARINES LOST",C$,C$,TAB 5
,"YOU SCORED ",A$
5001 LET M$=0$((1 TO (5-(LEN STR$
 M5C)))+STR$ M5C
5003 PRINT C$ TAB 5,"HI - SCORE
  ",H$
5004 IF M5C<T5C THEN PRINT C$,C$
 TAB 0,"A NEW HI-SCORE.",TAB 11,
 H$
5005 IF M5C<T5C THEN LET M5C=T5C
5006 FOR F=1 TO 10
5007 PRINT AT 7,10,"GAME OVER"
5009 FOR A=1 TO 2
5011 NEXT F
5013 PRINT AT 7,10,"PLAY AGAIN
5015 NEXT F
5020 PRINT AT 21,4,"PRESS ■ TO
■ TO REPLAY"
5026 FOR F=1 TO 2
5027 NEXT F
5029 PRINT AT 21,4,"PRESS NEULIN
E TO REPLAY"
5030 IF INKEY$<>CHR$ 118 THAN GO
 TO 5025
5033 GOSUB 1000
5040 GOTO 0
```

High resolution on the high seas — that destroyer will blast you out of the water if you surface. Even if you don't Grant Passmore's mines stand between you and safety.



CAN YOU navigate your submarine through a narrow channel without hitting the seabed or the surface? Fine. But can you also guide the craft through a lethal enemy minefield without getting blown up? Enough to give even the most experienced submariner a sinking feeling.

There are six skill levels and four game speeds. Each skill level increases the number of mines. The skill level and game speed both affect your score.

The program is in two sections, a 2K machine-code routine and a Basic listing. The game is contained in the machine code. The Basic sets the game speed, the number of mines and after each game gives a report and calculates your score. N/L is Newline.

To load the program, lower RAMtop:

POKE 16389, 103 (N/L)
NEW (N/L)

Next, reserve memory for machine code. You have to create a Rem statement 2,272 bytes long to do this.

Line 1. REM followed by 96 full stops.
Line 2 to line 18. REM followed by 122 full stops

You should now have a program consisting of 18 Rem lines. To make these 18 lines one

The hexadecimal loader.

```
4000 PRINT "START ADDRESS?"
4010 INPUT X
4020 CLS
4025 LET A=X
4030 PRINT X,":",
4035 FOR R=1 TO 8
4040 IF R=8 THEN INPUT R$
4045 IF R$="" THEN STOP
4045 PRINT R$( TO 2)
4050 POKE X,16*CODE R$+CODE R$(0
)-476
4060 LET R$=R$(3 TO )
4070 LET X=X+1
4080 NEXT R
4090 PRINT
4095 GOTO 4020
4100 PRINT "START ADDRESS?"
4110 INPUT X
4120 CLS
4125 PRINT X,":",
4130 FOR R=1 TO 8
4140 LET A=PEEK X
4145 LET R$(1)=CHR$ (INT (A/15)+
28)
4150 LET R$(2)=CHR$ (A-(INT (A/1
5)*15)+28)
4160 PRINT R$;
4170 LET X=X+1
4180 NEXT R
4190 PRINT
4200 GOTO 4100
```

Sea Mines hexadecimal dump.

```
16514 3E 1E ED 47 00 21 51 68
16522 C9 3E 0B ED 47 00 21 A7
16530 40 C9 21 00 07 0E C0 00
16538 20 36 96 23 10 F5 3D C9
16546 00 00 00 C9 21 DF E5 11
16554 11 21 00 00 13 1E 77 23
16562 10 FE 06 C9 ED 78 D3 FF
16570 10 CD CF A0 06 C2 00 40
16578 CD 92 02 CD 06 00 D0 01
16586 A7 40 C3 A4 02 E9 33 79
16594 BA 00 40 11 05 41 1A 77
16602 01 01 00 13 1E 77 23 10
16610 23 13 1A 77 23 13 0E 04
16618 06 05 1A 77 23 13 10 FA
16626 C5 01 1C 00 09 C1 0D 20
16634 EF 1A 77 23 09 24 FE 1E
16642 1A 77 C9 20 97 24 A6 1E
16650 1E 1E A2 96 1E 1E 1E 32
16658 1E 1E 99 1E 1E 1E 1E 1E
16666 1E 1E 97 25 2A D0 40 1E
16674 01 00 ED 52 3E 9E 77 01
16682 1F 00 09 77 C9 00 00 00
16690 77 23 03 77 23 03 00 00
16698 40 C9 2A 00 40 11 C6 00
16706 19 3E 9E 77 23 77 23 77
16714 11 1E 00 19 77 23 03 23
16722 23 77 CD D2 40 C9 0A 00
16730 40 00 3E 9E 77 11 1F 00
16738 19 77 23 03 77 11 77 13
16746 19 77 00 44 19 77 10 FC
16754 A3 23 23 77 CD D2 40 CB
16762 0F CD 00 40 03 3E 9E 77
16770 A3 00 16 77 16 16 00 04
16778 19 77 10 FC 20 28 28 28
16786 77 CD D2 40 C9 20 00 40
16794 00 00 CD D2 40 C9 00 00
16802 11 1C 00 CD 22 00 40 CD
16810 4A 00 CD 0C 42 2A D0 40
16818 D0 40 CD 0C 42 2A D0 40
16826 D0 40 F3 CD 00 40 3E 84
16834 06 08 D3 9F 3C 0D 87 84
16842 0D 85 01 1C 01 01 95 95
16850 95 95 95 95 95 95 95 95
16858 9E 9E 9E 9E 9E 9E 9E 9E
16866 9E 9E 9E 9E 9E 9E 9E 9E
16874 9E 9E 9E 9E 9E 9E 9E 9E
16882 9E 9E 9E 9E 9E 9E 9E 9E
16890 9E 9E 9E 9E 9E 9E 9E 9E
16898 9E 9E 9E 9E 9E 9E 9E 9E
16906 9E 9E 9E 9E 9E 9E 9E 9E
16914 00 00 00 00 00 00 00 00
16922 00 00 00 00 00 00 00 00
16930 00 00 00 00 00 00 00 00
16938 00 00 00 00 00 00 00 00
16946 00 41 3A 7C 40 FE 01 20
16954 0D 3A D0 40 11 21 00 19
16962 00 D0 40 11 41 00 19 00
16970 C3 3A D0 40 11 41 00 19
16978 00 E0 52 22 D0 40 CD 3C
16986 41 CD 00 40 22 22 2E 2E
16994 0E 2C 00 00 00 00 00 01
17002 22 22 22 22 6C 17 17 6C
17010 1E 17 9E 9E 00 00 00 00
17018 00 00 00 13 16 77 23 10
17026 A2 A2 32 32 A2 A2 32 32
17034 1E 1E 9E 9E 10 96 97 97
17042 97 97 08 9E 1D 96 97 A2
17058 A2 97 9E 9E 9E 00 97 A2
17066 22 00 17 A2 99 9E 9E 9E
17074 9E 9E 2E 9E 9E 22 9E 9E
17082 9E 9E 9E 9E 9E 9E 9E 97
17090 A2 32 32 9E 9E 22 A2 32
17098 9C 17 17 30 9E 22 A2 00
17106 97 9E 00 00 9E 1E 97 41
17114 97 9E 04 06 1E 77 23 41
17122 FC 19 0C 20 F8 3E 1E 01
17130 0D 65 06 16 77 23 10 FC
17138 00 21 30 06 11 1F 00 19
17146 77 18 77 23 23 10 F9 A1
17154 01 73 08 11 1D 00 19 77
17162 19 77 23 23 23 23 10 77
17170 77 19 77 11 05 00 19 10
17178 F4 21 A0 7C 06 16 11 19
17186 F4 21 30 7E 06 0C 11 0A
17194 00 19 F4 21 E6 78 11 21
17202 00 19 F4 21 E6 78 11 21
17210 17 00 77 19 77 11 0A 00
17218 19 10 F4 21 E6 78 11 21
17226 00 19 F4 21 E6 78 11 21
17234 7E 70 11 1F 00 86 0E 77
17242 23 77 19 10 F6 21 41 23
17250 77 23 23 23 23 23 23 77
17258 77 A3 77 23 23 23 23 77
17266 23 77 23 77 23 19 EF 15
17274 0E 06 21 30 7E 06 0C 11
17282 00 10 D1 13 10 F5 21 21
17290 7C 43 3E 11 77 21 15 6A
17298 11 74 42 CD 78 43 23 11
17306 74 42 CD 78 43 11 74 42
17314 CD 78 43 23 11 0C 42 CD
17322 78 43 11 74 42 CD 78 43
17330 97 11 74 42 CD 78 43 21
17338 97 0A 11 74 42 CD 78 43
17346 20 11 A4 42 CD 78 43 11
17354 0C 42 CD 78 43 11 5C 42
17362 CD 78 43 2B 11 5C 42 CD
17370 78 43 2B 11 5C 42 CD 78
17378 43 21 56 7A 11 5C 42 CD
17386 78 43 21 56 7A 11 6C 42
17394 CD 78 43 21 7C 11 6C 42
17402 77 21 0F 70 11 6C 42 CD
17410 78 43 21 10 7E 11 0C 42
17418 CD 78 43 21 1E 7D 11 6C
17426 42 CD 78 43 21 29 7E 11
17434 BC 42 CD 78 43 21 1F 7E
17442 11 C6 42 CD 78 43 21 1A
17450 70 11 C6 42 CD 78 43 21
17458 20 7E 11 C6 42 CD 78 43
17466 21 20 70 11 C6 42 CD 78
17474 43 21 44 1A 77 11 C6 42
17482 11 21 00 19 D1 00 02 1E
17490 77 23 13 1A 77 11 D0 11
17498 99 70 19 D1 10 F1 C9 00
17506 D9 70 19 D1 00 11 CE 42
17514 21 E9 7E 11 CE 42 CD 45
17522 44 21 F6 7E 11 CE 42 CD
17530 CD 45 44 21 E5 7D 11 CE
17538 42 CD 45 44 CD 70 0E FC
17546 7C FE FF C8 10 0E 11 1F
17554 00 19 FE EF 20 0A 3D CD
17562 09 FE EF 20 03 3D C9 3C
17570 CD 3A 78 40 3D CD 3A 78
17578 78 40 C9 3C FE 3F 20 02
17586 3D C9 3C FE 00 20 02 3D
17594 C9 FE EF 20 08 3E 3F C3
17602 3C FE 00 CB 32 7C 40 C9
17610 FE F7 C9 3A 78 40 3D CD
17618 04 CD 09 77 06 05 CD 30
17626 31 69 21 31 69 32 0A 44
17634 3E 00 32 09 44 3A D8 44
17642 CD 3A D8 44 3D 20 E7 52
17650 3D 20 E7 52 06 04 3A D8
17658 44 21 06 00 77 06 05 CD
17666 9E 30 19 19 19 F8 2A D8
17674 44 19 19 19 F8 2A D8 44
17682 19 19 77 06 05 CD 30 00
17690 48 11 32 00 CB 00 ED 00
17698 00 00 00 00 00 00 00 00
17706 DA 44 10 EA 10 E5 21 00
17714 EB 43 19 10 F7 23 23 7E
17722 FE 20 28 40 54 50 40 40
17730 25 29 29 29 29 10 22 32
17738 40 C9 29 29 29 29 10 22
17746 CF 40 C9 29 29 29 29 10
17754 22 CE 40 C9 3E 0A 32 7E
17762 0C 7E FE 0A 9E C2 E8 45
17770 ED 52 7E FE 0A 9E C2 E8
17778 45 23 10 F7 C9 00 00 00
17786 00 00 00 00 00 00 00 00
17794 19 7E 11 C6 42 CD 78 43
17802 3A D0 40 11 21 00 19 00
17810 D0 40 11 41 00 19 00 D0
17818 ED 52 7E FE 0A 9E C2 E8
17826 19 20 28 7E FE 0A 9E C2
17834 45 19 23 7E FE 0A 9E C2
17842 45 23 10 F7 C9 00 00 00
17850 C9 E8 45 23 10 F7 C9 00
17858 D0 40 11 21 00 19 00 D0
17866 7E FE 0A 9E C2 E8 45 23
```

SEA MINES

ZX-81

line enter the following direct commands:

```
POKE 16514 ,118 (N/L)
POKE 16515 ,118 (N/L)
POKE 16511 ,226 (N/L)
POKE 16512 ,8 (N/L)
```

Input line 4. Save "Sea Mine (Inv S)".

```
LIST 4 (N/L)
POKE 16419 ,4 (N/L)
```

Then enter the hexadecimal loader routine.

```
GOTO 9000 (N/L)
```

On the prompt enter 16514 then key in the machine-code listing. When you have finished, Save the machine code on tape a couple of times. To test the machine code, add the following lines:

```
10 RANO USR 18400
20 RAND USR 18433
30 STOP
GOTO 10 (N/L)
```

You should now have a picture of a submarine in a deep trench with a frigate waiting on the surface and the seabed climbing steeply up either side of the screen. There should also be a scattering of mines above the submarine.

Press key 6 — the down cursor — and the submarine should slowly move down to the sea bed and be destroyed. The program will then return to Basic with report code 9/30.

If it does not run correctly then lower RAMtop and reload the game from tape. Use the program in the hexadecimal loader routine starting at 9200 to check your machine-code listing against the published listing. Correct any mistakes you find and then rerun tbe test program. When the machine code has been debugged Save it. Delete all the lines from line 10 onwards.

Variables:

```
CLEAR (N/L)
```

Enter program 2 to assign the characters to T$. Then Run tbe program and enter tbe numbers in listing 1.

```
GOTO 10 (N/L)
```

Delete all the lines from line 10 onwards.

Never Run or Clear the computer, use Goto instead of Run.

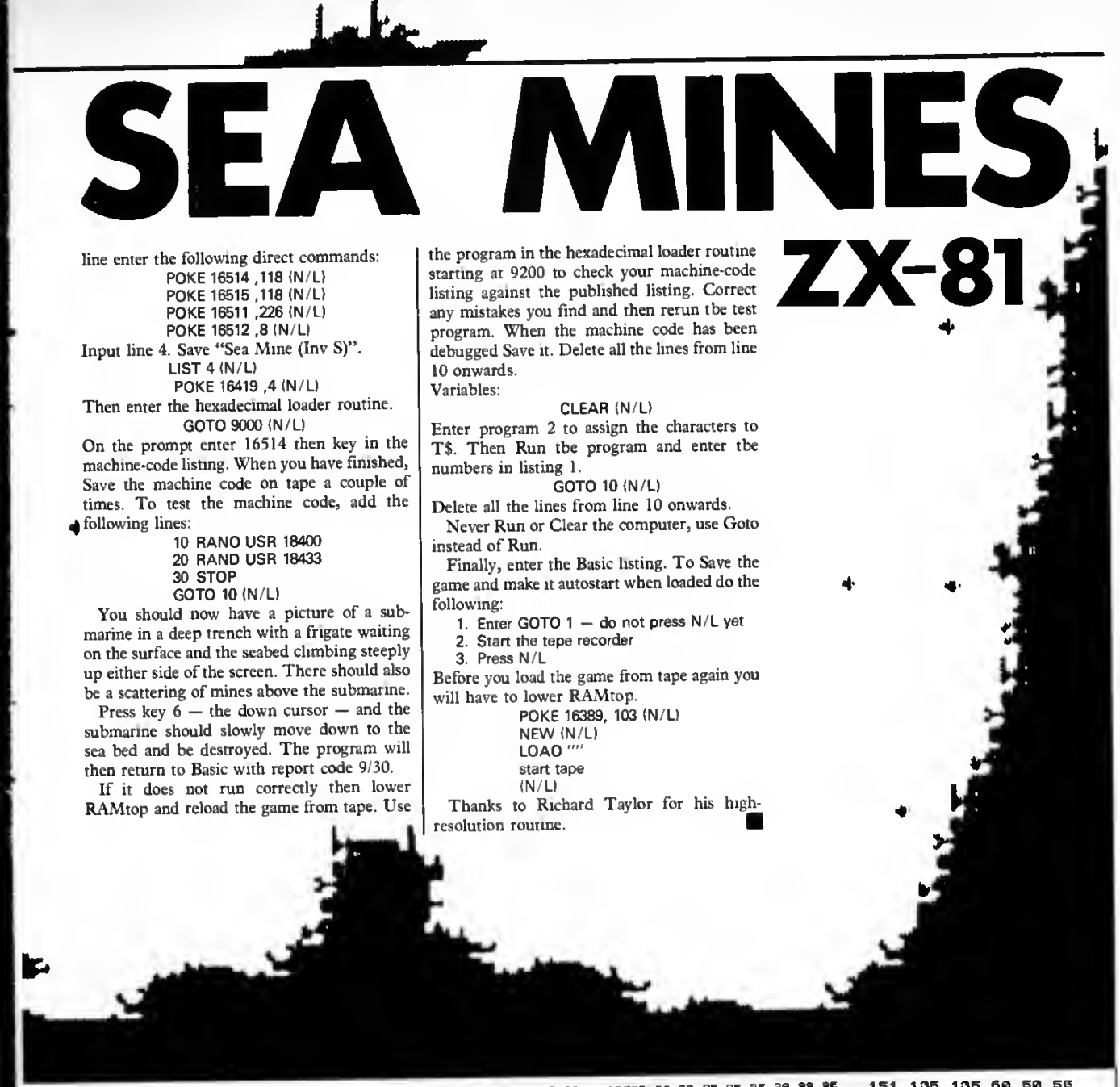
Finally, enter the Basic listing. To Save the game and make it autostart when loaded do the following:

1. Enter GOTO 1 — do not press N/L yet
2. Start the tape recorder
3. Press N/L

Before you load the game from tape again you will have to lower RAMtop.

```
POKE 16389, 103 (N/L)
NEW (N/L)
LOAD ""
start tape
(N/L)
```

Thanks to Richard Taylor for his high-resolution routine. ■



```
17874 F7 11 1D 00 19 7E FE 9E
17882 C2 E0 40 03 23 03 23 7E
17890 FE 9E C2 E0 40 C9 FE C9
17898 38 00 3E 9E 44 C9 CD 99
17906 1E 7C FE FF C8 7D FE F7
17914 00 7C FE FF C8 18 00 7C
17922 00 69 FE EF 28 30 C9 7C
17930 FE 9E 38 48 C8 7C FE DF
17938 38 7C 48 C8 7C FE DF 28
17946 48 3D 7C 48 3D C8 32 7C
17954 40 C9 FE 9E C2 E0 40 C9
17962 49 3C FE 03 C9 32 7C 40
17970 C9 FE F7 C9 3A 7B 40 C9
17978 FE 9E C8 3E 40 C9 21 00
17986 00 7C 32 7B 40 21 00 00
17994 22 79 40 CD 94 49 03 3A
18002 78 40 FE 81 CA 0A 46 FE
18010 80 CA 0A 46 3A D9 40 11
18018 01 00 CB 00 ED 52 7B FE
18026 20 00 CB 00 ED 52 7B FE
18034 9E C8 3E 9E C2 E0 40 23
18042 7E FE 9E C2 E0 40 47 19
18050 7E FE 9E C2 E0 40 47 23
18058 23 7E FE 9E C2 E0 40 47
18066 13 7E FE 9E C2 E0 40 C9
18074 C9 47 19 19 F7 C9 00 00
18082 2A D9 40 11 21 00 19 7E
18090 FE 9E C2 E0 40 47 19 7E
18098 FE 9E C2 E0 40 47 C9 00
18106 18 18 F7 11 40 00 C9 00
18114 ED 5B D9 40 7E 91 5F 23
18122 7E 98 57 11 40 00 C9 00
18130 19 7E FE 9E C2 E0 40 47 C9
18138 3A 7C 40 FE 01 CA 00 47
18146 ED 5B 79 40 7E 92 5F 23
18154 7E 93 57 19 7E FE 9E C2
18162 11 1F 00 06 02 19 7E FE
18170 9E C8 C5 47 03 23 7E 23
18178 9E C2 E0 40 C1 10 F7 C9
18186 FE 9E C2 E0 40 47 19 19
18194 19 13 13 00 04 7E FE 9E
18202 C2 E0 40 47 19 19 F7 C9
18210 00 C5 E5 47 19 19 7E FE
18218 9E C8 11 20 00 19 7E FE
18226 9E C2 E0 40 47 19 19 7E
18234 9E C2 E0 40 C9 C8 47 19
18242 19 F7 7E FE 9E C2 E0 40
18250 23 23 06 03 7E FE 9E C2
18258 E0 40 C8 47 23 23 26 20
18266 7E FE 9E C2 E0 40 47 C9
18274 00 7E FE 9E C2 E0 40 C9
18282 3A 7C 40 FE 01 CA A1 47
```

```
18298 2A D9 40 11 21 00 C9 00
18306 ED 52 7E FE 9E C2 C0 47
18314 19 00 23 7E FE 9E C2 C0
18322 47 23 03 00 00 7E FE C0
18330 C2 C9 47 23 19 19 F7 C9
18338 00 7E FE 9E C2 C0 47 03
18346 7E FE 9E C2 C0 47 03 10
18354 F7 11 1D 00 19 7E FE 9E
18362 C2 C0 47 19 00 23 7E FE
18370 9E C8 FE C0 C9 00 3E 03
18378 00 00 40 C0 3E 03 00 21
18386 00 C9 32 91 00 21 00 00
18394 70 22 D8 40 3E 91 36 00
18402 21 03 00 22 7B 40 CD
18410 49 21 03 00 22 7B 40 CD
18418 94 49 CB 00 CB 00 CB 00
18426 CB 00 CB 00 CB 00 7C FE
18434 00 CB 00 CB 00 CB 00 7C
18442 FE 00 CB 00 CB 00 CB 00
18450 CB 00 CB 00 CB 00 7C FE
18458 00 CB 00 CB 00 CB 00 CB
18466 00 CB 00 CB 00 7C FE 00
18474 CB 00 CB 00 CB 00 CB 00
18482 CB 00 CB 00 7C 40 3A 7C
18490 40 3A DE 40 CD 15 49 CD
18498 DF 47 20 09 3E 02 32 DE
18506 40 C3 E1 49 3A DE 40 3D
18514 CD 15 49 CD DF 47 20 09
18522 3E 03 32 DE 40 C3 E1 49
18530 3A DE 40 3D CD 15 49 CD
18538 DF 47 20 09 3E 04 32 DE
18546 40 C3 E1 49 3A DE 40 3D
18554 CD 15 49 CD DF 47 20 09
18562 3E 05 32 DE 40 C3 E1 49
18570 3A DE 40 3D CD 15 49 CD
18578 DF 47 20 09 3E 06 32 DE
18586 40 C3 E1 49 3A DE 40 3D
18594 CD 15 49 CD DF 47 20 09
18602 3E 07 32 DE 40 C3 E1 49
18610 3A DE 40 3D CD 15 49 CD
18618 DF 47 20 09 3E 08 32 DE
18626 40 C3 E1 49 3A DE 40 3D
18634 CD 15 49 CD DF 47 20 09
18642 3E 09 32 DE 40 C3 E1 49
18650 3A DE 40 3D CD 15 49 CD
18658 DF 47 20 09 3E 0A 32 DE
18666 40 C3 E1 49 3A DE 40 3D
18674 CD 15 49 CD DF 47 20 09
18682 3E 0B 32 DE 40 C3 E1 49
18690 3A DE 40 3D CD 15 49 CD
18698 DF 47 20 09 3E 0C 32 DE
18706 40 C3 E1 49 3A DE 40 3D
18714 CD 15 49 CD DF 47 20 09
18722 3E 0D 32 DE 40 C3 E1 49
18730 3A DE 40 3D CD 15 49 CD
18738 DF 47 20 09 3E 0E 32 DE
18746 40 C3 E1 49 3A DE 40 3D
18754 CD 15 49 CD DF 47 20 09
18762 3E 0F 32 DE 40 C3 E1 49
18770 3A DE 40 3D CD 15 49 CD
18778 DF 47 20 09 3E 10 32 DE
18786 40 C3 E1 49 3A DE 40 3D
18794 CD 15 49 CD DF 47 20 09
18802 3E 11 32 DE 40 C3 E1 49
18810 3A DE 40 3D CD 15 49 CD
18818 DF 47 20 09 3E 12 32 DE
18826 40 C3 E1 49 3A DE 40 3D
18834 CD 15 49 CD DF 47 20 09
18842 3E 13 32 DE 40 C3 E1 49
18850 3A DE 40 3D CD 15 49 CD
18858 DF 47 20 09 3E 14 32 DE
18866 40 C3 E1 49 3A DE 40 3D
18874 CD 15 49 CD DF 47 20 09
18882 3E 15 32 DE 40 C3 E1 49
18890 3A DE 40 3D CD 15 49 CD
18898 DF 47 20 09 3E 16 32 DE
```

```
18706 2A 00 9E 9E 9E 2A 99 9E
18714 9E 9E 9E 9E 2A 99 9E 9E
18722 9E 9E 9E 2A 99 9E 9E 9E
18730 9E 9A 9A 9E 9E 17 1E 1E
18738 1E 1E 1E 1E 1E 1E 1E 1E
18746 1E 1E 1E 1E 1E 1E 1E 1E
18754 A2 1E 1E 1E 1E 1E 1E 0C
18762 48 21 9F 87 9E 9C 99 99
18770 1A 77 19 21 00 18 FA 09 11
18778 1A 77 19 21 00 00 FE C9
18786 18 00 84 90 00 F8 89 38
18794 00 00 39 2E 33 9A 99
19900 99 76
```

Program 2.

```
10 DIM T$(342)
20 FOR N=1 TO 342
30 INPUT B
40 LET T$(N)=CHR$ B
50 PRINT CHR$ B;
60 NEXT N
```

Listing 1.

```
153 64 34 34 46 46
14 34 34 23 23 139
36 23 34 34 34 140
23 23 34 1 32 23
155 153 153 14 34 34
14 45 34 34 34 140
23 140 34 23 23 23
34 23 132 30 17 23
166 166 155 153 64 3
34 34 23 140 34 34
23 23 23 139 30 23
23 132 30 32 132 23
29 29 29 161 162 151
161 152 151 161 162 55
30 30 151 143 50 152
151 151 60 30 50 56
155 11 11 166 152 162
```

```
151 135 135 60 50 56
162 152 152 152 55 162
162 152 136 170 32 30
155 156 156 11 150 151
151 151 151 152 162 162
162 143 143 30 30 36
30 50 50 50 152 59
156 156 155 11 151 152
152 151 151 133 50 162
11 155 155 29 151 151
162 151 11 155 155 155
156 155 156 156 11 150
151 151 151 11 156 151
155 161 151 151 11 153
160 151 151 150 156 166
155 155 22 150 161 151
151 161 11 153 29 150
151 152 151 151 11 156
155 11 151 152 162 151
155 45 14 34 54 15
155 155 45 155 155 153
3 23 34 23 23 34
46 34 54 163 155 156
166 166 166 153 3 3
34 34 23 34 153 156
155 46 166 155 46 156
45 34 14 45 34 155
166 166 166 155 155 46
45 45 34 34 14 45
45 34 23 23 34 46
155 155 155 45 45 156
11 11 151 25 50 151
162 56 56 44 19 55
136 60 50 30 50 35
29 28 28 6 52 143
143 30 30 166 155 45
34 57 140 23 23 46
153 14 34 34 140 23
23 17 155 156 15 34
45 22 20 30 23 36
```

6809

All aboard the Dragon express with John Nash for speed and economy.

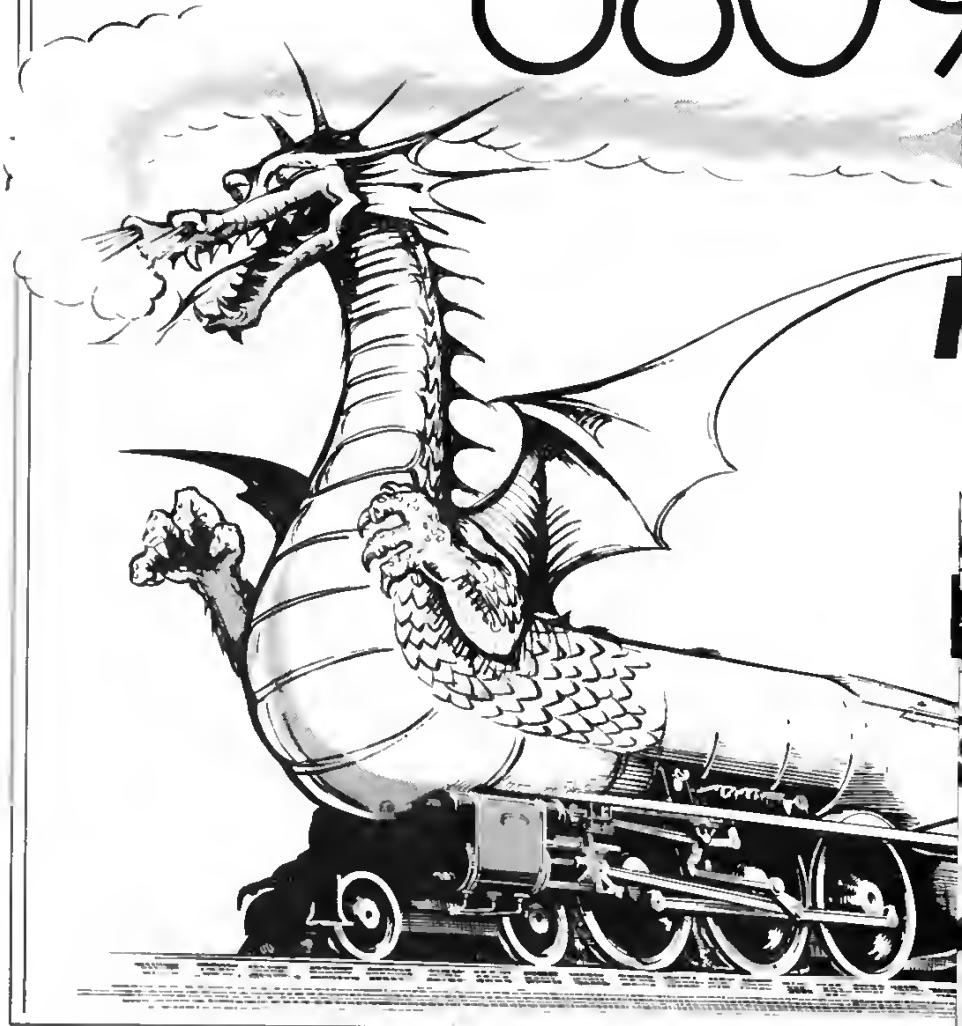


Figure 1a.

```
10 PMODE4:PCLS:SCREEN1,1
20 FORN=1536 TO 7679 POKEN,192 NEXT
```

Figure 1c.

```
00100              ORG     32250
00110 INIT         LDA     #192
00120              LDX     #1536
00130 LOOP         STA     ,X+
00140              CMPX    #7679
00150              BHS     OUT
00160              BRA     LOOP
00170 OUT          RTS
00180              END
```

Figure 2.

```
00100              ORG     32250
00105 START        LDU     #100
00110 INIT         LDA     #192
00120              LDX     #1536
00130 LOOP         STA     ,X+
00140              CMPX    #7679
00150              BHS     OUT
00160              BRA     LOOP
00170 OUT          LEAU    -1,U
00180              CMPU    #0
00190              BEQ     FINISH
00200              BRA     INIT
00210 FINISH       RTS
00220              END
```

Figure 3.

```
00100              ORG     32000
00110 SSTART       LDY     #32512
00120              LDX     #4639
00130 STLOOP       LDA     ,X
00140              STA     ,Y+
00150              LEAX    32,X
00160              CMPX    #7679
00170              BEQ     STDONE
00180              BRA     STLOOP
00190 STDONE       LDX     #7679
00200 MLOOP        LDA     ,-X
00210              LEAY    1,X
00220              STA     ,Y
00230              CMPX    #4608
00240              BEQ     RSTART
00250              BRA     MLOOP
00260 RSTART       LDY     #32512
00270              LDX     #4608
00280 RELOOP       LDA     ,Y+
00290              STA     ,X
00300              LEAX    32,X
00310              CMPX    #7640
00320              BEQ     REDONE
00330              BRA     RELOOP
00340 REDONE       RTS
00350              END
```

Figure 4d.

```
1 REM MACHINE CODE DECIMAL LOADER
2 REM PUT THE CODES INTO DATA STATEMENTS, AS MANY AS YOU NEED, BETWEEN LINES 10
- 49.
3 REM THEN RUN THE PROGRAM AND ANSWER THE PROMPTS.
4 REM FOR THE FIRST 0LOCK OF MACHINE CODE FOR THE FLIGHT SIMULATOR, S WOULD BE 3
2256, AND N WOULD 0E 102.
5 REM SET THE PARTITION 0EFORE YOU START, E.G. CLEAR1000,32250
10 DATA20,FF,7F,40,etc.
20 DATAetc.
50 INPUT"STARTING ADDRESS DECIMAL:",S:S=S-1
60 INPUT"NUM0ER OF CODES, DECIMAL",N
70 FORX=1 TO N:READA$ POKE(S+X):VAL("&H"+A$) NEXTX
71 REM TO LOAD DECIMAL CODES, LINE 70 WILL 0E  FORX=1 TO N READA POKE(S+X),A:NEX
TX
80 CLS:PRINT"COMPLETE. NOW SAVE IT AS A","M/C TAPE FILE AND THEN ERASE ","THIS B
ASIC PROGRAM"
```

Figure 1b

```
FORTH PROGRAM TO FILL SCREEN WITH STRIPES

: FILLSCREEN 7680 1536 DO 192 C! LOOP ;

: SWITCHON 0 65475 C! 0 65477 C! 0 65479 C! 255 65314 C! .

: REVERT 7 65314 C! ;

: TEST SWITCHON FILLSCREEN REVERT .

Comment- switchon Puts display into hires. and revert goes back to text.
```

THE DRAGON is a fast computer by current standards, and much of the credit for this must go to its excellent processor, the 6809E. The Basic is also one of the fastest available in a home micro. So why use machine code? And when do you need to use it?

There are two principal reasons for using machine code: speed and efficiency. First, speed. Consider the programs in figure 1, which all fill the high-resolution screens with stripes. This is done by Poking 192 to every address from 1536 to 7679. In Basic this takes 41 seconds, in Forth, 1.17 seconds, and in machine code, 0.11 seconds. So the interpreted language, Basic, is nearly 400 times slower than machine code, and even the

Figure 4e

```
10 REM STRIPE TEST
20 PMODE3:PCLS:SCREEN1,1
30 EXEC32250
40 GOTO40
10 REM LATERAL SCROLL TEST
20 PMODE4:PCLS:SCREEN1,1
30 CIRCLE(128,96),95
40 EXEC32000
50 GOTO50
```

EXPRESS

MACHINE CODE FOR THE DRAGON



compiled language, Forth, is 10 times slower. Why the difference?

Imagine you are on holiday in France, and do not speak any French. You would have to look up every word in the dictionary. This is what Basic has to do when it runs. Unlike you, however, it does not learn, and so will not improve with practice.

You might, alternatively, use a phrase book, which would be quicker. This is analogous to Forth, in which you compile your "words" before running the program. The best method, however, would be to learn fluent French, and this would provide the fastest communication of all. This is what you are doing with machine code — talking the machine's own language.

Second, efficiency. Machine code takes up far less space than Basic because the instructions are more compact, and the storage of numbers or variables also takes far less space for most applications. The saving in space can be very important if you want to keep most of the Dragon's memory free for data storage in, say, a file or word-processor program.

You could ambitiously start writing arcade games in machine code, but I would advise gaining some experience on simpler programs first. As a start, if any repetitive procedure in Basic is too slow, put it in machine code and then call it from your Basic program. This will give a staggering improvement in graphics games, as well as text handling programs. Machine-code programs can be called from Basic using the Exec (address) instruction.

Machine-code programming is much faster and easier if you have an assembler. In fact, if you intend to do any serious machine-code programming, an assembler will be essential. They are available in both tape and cartridge versions, the cartridge ones being more convenient and using less memory, but usually at a higher cost. As an example, I shall describe Tandy's Edtasm, which is the one I use.

Really intended for the Color Computer, this cartridge nevertheless works well with the Dragon, although ROM differences prevent a few of the system commands from working. This is not serious, as there are simple alternative ways of achieving the same ends. I include details of how to do this in an appendix at the end of this article. It is a superb system, from Microsoft, and sits in the 8K cartridge area of memory.

It enables you to enter, edit and assemble programs in 6809 mnemonics, and direct the code to anywhere in the RAM. Good error messages are produced, and the package includes the standard Microsoft Editor, and many other functions such as renumber. A separate program, also in the cartridge, called Zbug, enables you to alter or inspect memory or 6809 registers, run programs with breakpoints or by single-stepping, and many other debugging functions. It also contains a useful decimal to hexadecimal and octal converter, as well as a calculator.

The assembler uses the RAM addresses from 600h onwards, and the program listing starts at 800h. This area of memory is the high-resolution. screens, which can of course be overwritten by graphics programs. Thus it is usually best to assemble machine-code subroutines to the end of memory, say 7E00h. It is also essential to store a copy of the assembler text program on tape before running or returning to Basic. Returning to Basic clears the assembler text buffer, but conversely, the assembler will not corrupt the Basic unless you are handling an enormous program which reaches beyond 7680 decimal — 1E00 hexadecimal — which is the usual starting address for the Basic program, with the default setting of PClear4. Thus, machine code and Basic programs can coexist in the machine, and using the assembler need not destroy your Basic. Fitting programs into the memory will be covered in more detail in a later article.

Many useful machine-code routines, and indeed many programs, have the general form:

- Do something
- Increment counter
- Check to see if you heve reached limit
- If so, stop: if not, repeat procedure

In Basic, this is the For-Next loop. Another frequently-used one is the conditional test:

- Do procedure
- Test some parameter
- If it = A then go elsewhere
- If it = B then repeat

These two general forms embrace quite a high proportion of programs or subroutines. They are fairly easy to code in machine code — the only real difficulty is stating the problem clearly. See for example, figure 1 again. The left-hand column contains the symbols or labels which are used for your convenience. The assembler will convert them to numbers representing addresses as necessary.

The next column contains the commands. These are the actual machine-code instructions. The third column contains the operands: the numbers on which the instructions will operate, which may represent numerical data, or addresses.

The last column is for comments — ignored by the assembler. Line numbers are also provided by the system monitor; these two are ignored by the assembler.

Now to dissect the routine in detail:

LDA # 192: This loads the eight-bit A register with 192d, # indicetes immediete addressing,

(continued on page 129)

Figure 4a.

```
7DFA                    00100           ORG     32250
LNE AT ADDR. 32250
7DFA 86   C0            00110 INIT      LDA     #192
7DFC 8E   0600          00120           LDX     #1536
7DFF A7   80            00130 LOOP      STA     ,X+
7E01 8C   1DFF          00140           CMPX    #7679
7E04 24   02            00150           BHS     OUT
7E06 20   F7            00160           BRA     LOOP
7E08 39                 00170 OUT       RTS
          0000          00180           END
00000 TOTAL ERRORS
INIT    7DFA    LOOP    7DFF    OUT     7E08
```

Fibure 4b.

```
7DFA                    00100           ORG     32250
LNE AT ADDR. 32250
7DFA CE   0064          00105 START     LDU     #100
7DFD 86   C0            00110 INIT      LDA     #192
7DFF 8E   0600          00120           LDX     #1536
7E02 A7   80            00130 LOOP      STA     ,X+
7E04 8C   1DFF          00140           CMPX    #7679
7E07 24   02            00150           BHS     OUT
7E09 20   F7            00160           BRA     LOOP
7E0B 33   5F            00170 OUT       LEAU    -1,U
7E0D 1103 0000          00180           CMPU    #0
7E11 27   02            00190           BEQ     FINISH
7E13 20   E8            00200           BRA     INIT
7E15 39                 00210 FINISH    RTS
          0000          00220           END
00000 TOTAL ERRORS
FINISH  7E15    OUT     7E00
INIT    7DFD    START   7DFA
LOOP    7E02
```

Figure 4c.

```
7D00                    00100           ORG     32000
7D00 108E 7F00          00110 SSTART    LDY     #32512
7D04 8E   121F          00120           LDX     #4639
7D07 A6   84            00130 STLOOP    LDA     ,X
7D09 A7   A0            00140           STA     ,Y+
7D0B 30   8B 20         00150           LEAX    32,X
7D0E 8C   1DFF          00160           CMPX    #7679
7D11 27   02            00170           BEQ     STDONE
7D13 20   F2            00180           BRA     STLOOP
7D15 8E   1DFF          00190 STDONE    LDX     #7679
7D18 A6   82            00200 RLOOF     LDA     ,-X
7D1A 31   81            00210           LEAY    1,X
7D1C A7   A4            00220           STA     ,Y
7D1E 8C   1200          00230           CMPX    #4608
7D21 27   02            00240           BEQ     RSTART
7D23 20   F3            00250           BRA     RLOOP
7D25 108E 7F00          00260 RSTART    LDY     #32512
7D29 8E   1200          00270           LDX     #4608
7D2C A6   A0            00280 RELOOP    LDA     ,Y+
7D2E A7   84            00290           STA     ,X
7D30 30   88 20         00300           LEAX    32,X
7D33 8C   1DE0          00310           CMPX    #7648
7D36 27   02            00320           BEQ     REDONE
7D38 20   F2            00330           BRA     RELOOP
7D3A 39                 00340 REDONE    RTS
          0000          00350           END
00000 TOTAL ERRORS

RLOOP   7D18    SSTART  7D00
REDONE  7D3A    STDONE  7D15
RELODF  7D2C    STLOOP  7D07
RSTART  7D25
```

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CITY _____

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COMPUTER MODEL _____ **COMPUTER RAM** _____

(continued from page 127)

i.a., a number.

LDX # 1536: this loads the 16-bit X register with 1536d — the start of hi-res screens Wa have now initialised, and are about to enter the looping part of the program.

STA ,X+: this is a useful instruction which takes advantage of the auto-index facility of the X register. Do not worry about the datails at the moment: addresing will be covered in a future article. What this instruction does is to store the contents of A, 192, in the register 1536 whose address is in the X register, then increment X by one, making it 1537.

CMPX # 7679: compares the contents of X, 1537, with the number 7679 and sets a flag to indicate the result.

BHS OUT: checks the flag, and branches to Out if X was the same as or higher than 7679.

BRA LOOP: if we had not finished, we would not branch to Out and so reach this instruction — Branch Always to Loop.

Finally, if we reached Out, we encounter RTS, which is simply Return From Subroutina. Note that, when running programs from the monitor cartridge, you may need SWI — software interrupt — instead. See your own assembler manual.

END: this is an instruction to the assembler that it has finished and can now relax. End is not compiled as a machine-code instruction.

Now look at figure 2. This routine uses the 16-bit U register as an additional counter to repeat the loop 100 times. LDU # 100 is fairly straightforward, but what is tbe LEAU — 1,U doing? This is an example of the Load Effective Address or LEA instruction, to be discussed in more detail in a future article. It subtracts 1 from the value in the U register.

BEQ is another branch instruction: Branch on Equal. This only branches when the two values being compared are equal.

Finally, look at figure 3. This is a program to scroll part of the screen one byte at a time, laterally. This could be useful in a program of the scramble type, for example, to move the ground. See if you can work out how it works; hint — it stores the value of the end byte of each line before scrolling, and puts these back to the opposite end of the screen to achieve wrap around.

What if you do not have an assembler? You will find programming more difficult, as you cannot use labels, and all branch instructions have to be converted to relative addressing. You would also be well advised to stick to hexadecimal numbers, as this will save errors in conversion and other misunderstandings.

If you do not understand hexadecimal numbers, you will find useful sections on base arithmetic in most school maths textbooks. Another concept you will need to grasp is two's complement arithmetic, which is needed for calculating relative addresses for branch instructions.

As this applies to eight-bit arithmetic, you can find the two's complement of a decimal number by subtracting it from 256, and then converting to h. Thus the largest positive eight-bit or 2c number is 127 — 7F — and the largest negative number is — 128 — 80 h.

For the present, however, I have given the full assembly listings of the programs in the article, in figure 4. The extra three columns of the assembler listing in figure 4 are, left to right, address, command, operand — all in b. To enter these codes, use the short Basic program also shown in figure 4d. This is the standard machine-code loader, and can be used for loading either d or h codes by modifying line 70 as shown. When loaded, the routines can be run from Basic using an Exec or Address command.

The most important Edtasm functions which do not match up with the Dragon ROM are Q — quit, to Basic — and tape saving. I have found the following methods suitable: to return to Basic, get into Zbug and type GB400. This restarts the Basic system, but also clears your Basic program. GB4AA will also restart Basic and leave your Basic program intact which saves time.

This address, however, does not restart Basic quite properly, because the first RAM operation will give an OM error. Just carry on, and you will find that the system is then back to normal. I usually purge this error by typing 7E as part of the restart procedure.

To Save files to tape, I first use Zbug's U or block transfer function to make a copy of the file at a safe address: 16000 is suitable. I copy the addresses from 600h to about 0C00 for a short program, or 1400h for a long one. Once the copy is made, I return to Basic as above, and immediately tape the file using Basic's CSaveM function in the usual way, copying the block from 16000d onwards. To reload, I reverse the procedure, first loading the tape file to 16K onwards, then starting up Edtasm with Exec 49152, then using the U function to copy the file from 16000 back to the editing/assembling area starting at 600h. ■

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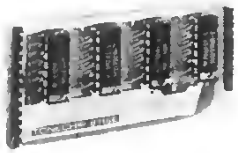


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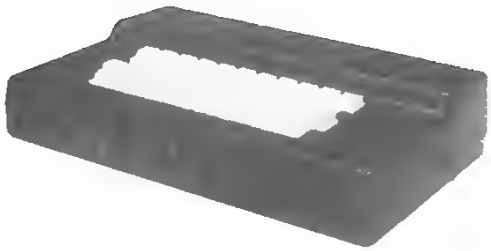
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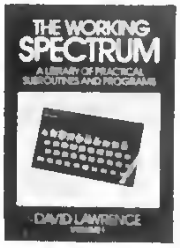
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"Let me look at that" I said and after another 10 or 15 seconds up came the paragraph in *Birch's Medical Emergencies* in whicb acupuncture is mentioned as one cause of a penetrating wound of the chest wall. The reference is so slight that it migbt well not appear in the formal index to the book but Colleague, a new medical information retireval service, had found it from among thousands of millions of stored characters and words.

At present, the Colleague system run by Bibliographic Retrieval Services is based in the USA, just north of New York. The system uses sophisticated software to map the position of keywords in books and journals such as the *New England Journal of Medicine* and the *Lancet* which allows the use of the database in real time. It is so fast that Colleague can be useful to a doctor or research worker while they are carrying out a task.

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[continued on page 135]



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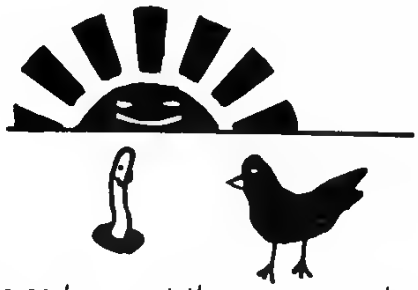
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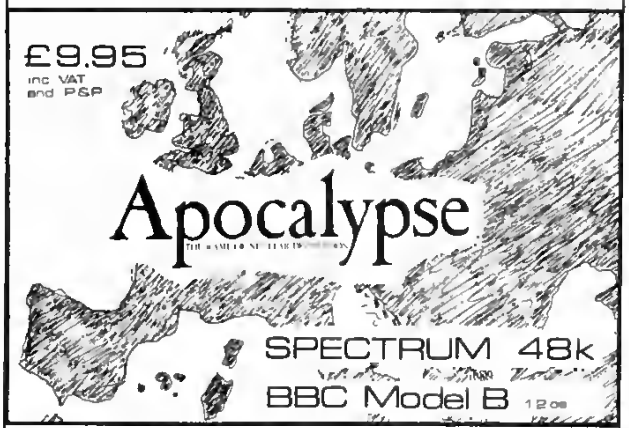
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(continued from page 133)

when you think about Prestel, the flow is unequal — there is comparatively little information going from me to the computer and a great deal coming back from the computer to my visual display unit.

Within a computer, data is transmitted along parallel or serial buses in digital form, so the signal is either on or off. The standard RS-232C protocol was intended originally to connect one part of a computer to another, a line printer, for example, to the central processor unit. The RS-232C protocol is fairly robust in operation — I have used a printer connected directly to a Televideo 950 terminal by 50 metres of cable at 2400 Baud without any difficulty — but it was never intended to span the Atlantic and would fail before you had crossed the low water mark of a Cornish beach.

Modems are pieces of equipment that turn the digital electrical signals used by computers into analogue signals suitable for transmission over long distances. The term Modem is contracted from the two words modulator and demodulator because the purpose of the equipment is to impose the digital signals from the computer on to a carrier signal — to modulate the carrier — while the digital information is recovered at the far end by the opposite process of demodulation.

Microcomputers almost invariably use a form of transmission known as asynchronous communication. Asynchronous communication is transmission in which each information character is individually synchronised by the use of start and stop elements because the interval of time between characters can vary. Synchronous transmission is used more often between large computers because the equipment and software exists to hold the elements of the computer rigidly in time with each other. Information can also be transmitted more rapidly as there is no need to add start and stop bits to the front and end of every character.

The actual rate of transmission may be very fast using a synchronous protocol — bundreds of thousands or millions of characters per second. Asyochronous protocols such as that used by Prestel or Colleague, or any system utilising the Public Switched Telephone Network, or PSTN, work more slowly. Prestel takes information from the user at about 7.5 characters per second and transmits information at about 120 characters per second. Colleague will adjust itself automatically to the equipment of the user and can accommodate up to 120 characters per second. That is the practical limit for an ordinary telephone line and often 30 characters per second, which corresponds to 300 Baud, is the fastest rate that will get a message down a line witbout disabling corruption.

Special telepbone lines will handle faster data transmission rates but, in return, you lose portability because the equipment is effectively fixed to the end of the special line and the rental costs rise considerably.

Amateur or domestic microcomputer users in the USA are well ahead of their British counterparts in terms of connecting Modems to their microcomputers, although the Britisb Prestel system has the largest number of users of any videotext system in the world. The previous attitudes of the GPO, now British Telecom, contributed significantly to the lack of progress in this country. Modems have to be approved by the Post Office or BT and that used to be a long drawn out and frustrating procedure.

Renting a Post Office Modem was expensive and the installation delays were enougb to make many people consider the advantages of carrier pigeons. These attitudes are changing and may be expected to continue to become more customer friendly as microcomputer users start to explore outside the limited applications that are possible using an isolated system.

Networking was one of the buzz-words of last year or the year before, but it is true that the ability to communicate with other machines is a key element in the development of information technology. The Colleague system would be impossible to implement witbout Modems and the ordinary, familiar telephone in your office or home

Commercial Modems are still quite expensive although some acoustic couplers — devices that use the telephone handset to transmit and receive the tones that form the modulated carrier signal rather than making direct electrical connection to the telephone line — have become cheaper in the last year.

Maplin Electronic Supplies has produced a direct connection Modem as a kit and a number of interface boxes that will connect the Modem to a range of domestic microcomputers. The Maplin Modem is cheap and, according to research workers and doctors who are using it, highly satisfactory.

The photograph on page 133 shows the components of the Modem as it arrived for this review. The main board is a single sided glass fibre board of good quality. The tracks are all tinned and there is no additional gold-plating on the connections to the plug from which wires lead to the power supply and the isolating transformer. This is really not necessary, however, as you are unlikely to plug and unplug the board from the socket on more than a few occasions.

The components are all of a higb standard and many of the resistors are rated as one per cent accurate using the new four-band colour codes. The Modem transmits and receives at the single speed of 300 Baud and uses standard European CCITT tones. One of the chips used in the Modem kit can be configured to generate American tones althougb this is not mentioned further in the excellent construction notes. The Modem uses a British Telecom approved isolating transformer and may be submitted after construction to the appropriate local BT office for official clearance.

The kit contains between 80 and 90 resistors and it took me some time to locate the position for each of these as the board does not follow an obvious left to right plan for the component numbering. However, the silk screened component layout is clear and you should have no difficulty in completing the construction of the board provided you do not rush.

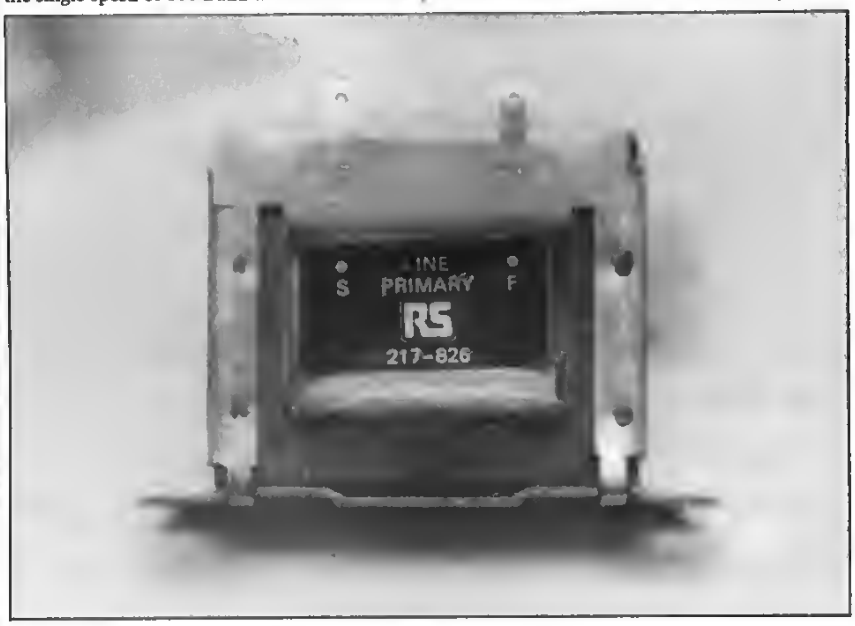
Many of the resistors' values have had to be synthesised from two components to match the calculated values for the bandpass filters. Incorrect assembly will degrade the performance of the filters — these are the key elements of the Modem design.

The construction notes suggest that you will need an oscilloscope to complete the setting up procedure and I cannot see any way of avoiding those stages other than by pure luck. The procedure is not hard to follow but you will require access to an oscilloscope and a voltmeter for routine voltage checking. The kit of parts contained a slip correcting some errors in the construction notes and one replacement resistor which has been substituted for a different value in the original design was wrapped in a separate plastic bag. This degree of attention to detail is unusual among kit suppliers and indicates a welcome concern by Maplin Electronics that you should succeed in building and operating the Modem.

Maplin, incidentally, is sufficiently sure of the quality of the Modem to have started Cashtel, a computerised shopping service. You can dial 0702 552941 and access the Maplin computer which will give you details of any item in the Maplin catalogue, including the quantity currently in stock. Using a credit card number and a special Maplin shopper's number you can then order what you want.

Remember that a Modem is a piece of hard-

(continued on page 137)



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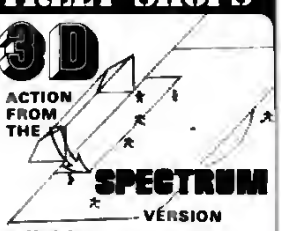
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➡ ***Although I'm no great football fan, I really enjoyed playing this game — excellent use is made of colour and user-defined graphics The game is very logically put together, so that the development of strategy and tactics has a real effect. For example, one of my teams got through to the fourth round of the F.A Cup where it was beaten by a second division side This upset morale and meant that our promotion bid failed Perhaps I should have given up the F.A Cup run and held some good players back — the possibilities are endless. Brian Clough had better watch out!***
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REMEMBER time is all important—so!

(continued from page 135)

ware that extends the electrical connections you can make with your microcomputer. The software that will program the computer to make use of the Modem is another matter. Prestel software is well suited to some jobs and not to others. The Colleague software is enormously sophisticated and is far more suitable for many information retrieval purposes.

Both of these systems demand almost no machine intelligence at the user's terminal; Prestel requires only a numeric keypad as the minimum input capability and Colleague will work quite adequately with a dumb alphanumeric terminal. For some tasks you will need programs to transfer information from disc to the Modem or vice versa.

The PIP, or Peripheral Interface Program, in CP/M can be used to set up a serial port as the chosen input and output device and I have seen two RML 380Z computers connected through two Maplin Modems and sharing files after less than 20 minutes work configuring PIP.

The social and political effects of such a simple device as a Modem are far-reaching and should not be dismissed. Research workers in university medical departments have complained loudly and with justification about the effects of cuts on medical staffing. However bad that situation is, there is no doubt that many professors are even more worried about staffing levels among technical and clerical staff. If a department is unable to keep its filing up to date then after a few years there will be no working reference system and research staff will be unable to read about work in progress at similar centres in other countries and the

MODEM



quality of UK research will suffer immeasurably.

If a professor or senior lecturer spends time doing his or her own filing then other work does not get done and that is a grossly uneconomic way to spend a senior lecturer's salary. Colleague may be the way out of this impasse. If the full text of the original papers you need is available on demand, and if it is easier to find because your own alternative is a card index or a simple electronic equivalent on a microcomputer, then Colleague looks very attractive.

But without a paper hard copy of the original how can you guarantee that it is as the author wrote it? Do you remember Winston Smith's job in George Orwell's *1984*? He worked for the Ministry of Information "rectifying" inaccuracies in *The Times* and other newspapers:

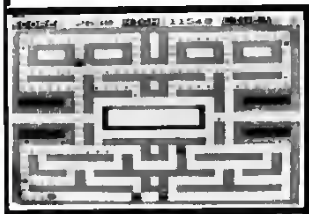
"times 17.3.84 bb speech malreported africa rectify" said the internal Ministry of Information memorendum. "The messages he had received referred to articles or news-items which for one reeson or another it wes thought necessary to alter . . . it appeared . . . that Big Brother, in his speech of the previous day, had predicted that the South Indian front would remain quiet but that a Eurasien offensive would shortly be launched in North Africa . . It was therefore necessary to rewrite a peragraph of Big Brother's speech . . . when any particular number of *The Times* had been assembled end collated, that number would be reprinted, the original copy destroyed, and the corrected copy placed on the files in its steed . . . Dey by day end almost minute by minute the past wes brought up to date."

Now 1984 is only four months away and who needs all those staff to collate and reprint and file paper copies when it can all be stored on cheap magnetic and video discs, accessed instantly and "rectified"? Would it not be convenient to modify something personally or politically inconvenient just a little bit. Even in research there must be a temptation to rewrite the conclusions of an old paper in the light of subsequent experience — change the emphasis here or there to reflect or foreshadow later knowledge.

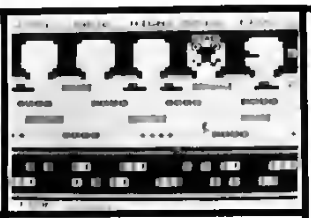
Unless this technology is managed consciously we shall all be the losers to expediency and opportunism. Electronic communication between machines is an enormously important step — swapping games programs may be trivial but there are many good and serious applications. Choosing those applications and rejecting those that will, or may, cause social or political damage is hard work. ■

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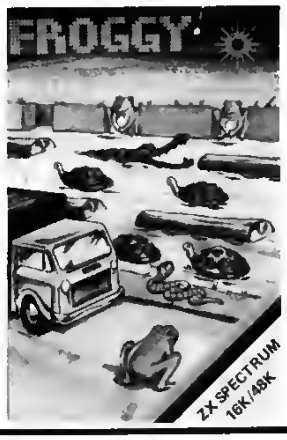
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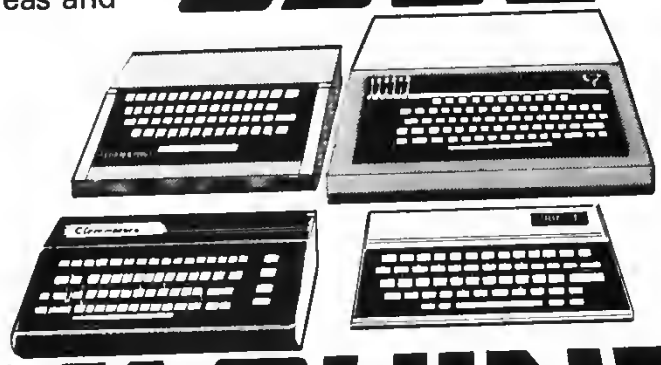
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6502 MACHINE CODE MADE EASY

Darryl Mattocks presents a complete program for space invaders using 6502 machine code. He outlines the five main problem areas and how to solve them.



SURELY MOST people who are even vaguely interested in computer games must, at one stage or another, have tried to program a version of space invaders. Although it looks a simple enough task, once all of the checks are in to provide a good game, Basic is invariably far too slow to enjoy this masterpiece. Let us try machine code.

The main programming problems are drawing the screen, moving the invaders from side to side and down the screen, moving the ship from side to side, firing up at the invaders, and scoring. Once these five points have been overcome, frills can be added such as the invaders changing colour, a mystery ship and so on.

The first problem is drawing the screen. The easiest way to do this is just copy a ready-drawn picture of the screen from memory. This is done very quickly using the routine

```
      LOY #00
      LOX (NUMBER OF BYTES TO BE
      COPIED)
LOOP  LOA (SOURCE),X
      STA (DESTINATION),X
      DEX
      BNE LOOP
      RTS
```

where Source is the address of the data to be copied and Destination is the address of where the data is to be copied to.

This routine is used twice, once for the score at the top of the screen and once for the defences at the bottom.

Now we have to plot the invaders. This is done separately from the rest of the Draw routine so that the invaders can be moved to lower start positions every fourth sheet. Although all of the invaders look the same there are really two distinct types; one of these moves from left to right, and moves down a line when it reaches the right, and vice versa. By doing this we can use a groovy little routine which I call the Scan routine.

The operation of this routine can best be seen using the program shown in figure 1 which, as it is in Basic, is slow enough to watch working. But now try and move things down the screen by changing line 30 to

```
30 IF PEEK(C)=5 THEN POKE C,32:
POKE C+40,5
```

(continued on page 143)

Figure 1.

```
2 REM ***** BASIC SCAN ROUTINE
3
4 REM ***** SET UP THE SCREEN
5 C=1063
6 C=C+1 POKEC,32 IFRND(1)<.11THENPOKEC,5
7 IFC<1983THEN6
10 C=1064 REM ***** START OF SCREEN
20 C=C+1 IFC=1983THEN10 REM ***** FINISHED ?
25 REM ***** IF THE CHARCTER ON THE SCREEN IS
26 REM ***** AN 'E' THEN MOVE IT UP
30 IFPEEK(C)=5THENPOKEC,32 POKEC-40,5
35 REM ***** DISPLAY THE COUNTER POSITION
40 PRINT"■                ■";C
50 GOTO20 REM ***** REPEAT FOR THE NEXT SPACE

READY.
```

Listing 1.

```
10 RESTORE PRINT"□"
15 FORI=0TO15 POKE4**4096+1,0 NEXT REM RESET VARIABLES
20 READA IFA=-1THEN100
30 POKE10432+R,A R=R+1 PRINT"■       ";"1062-R W=W+R GOTO20
100 PRINT"■DATA ITEMS ENTERED =";"R"  (1062)"
110 PRINT"■SUM OF DATA       =";"W"  (105351)"
120 IFW=105351THENPRINT"■***** CODE OK *****"
130 IFW<>105351THENPRINT"■       CODE ERROR          ■"
140 PRINT"■HIT ■■ TO START"
150 GETA$ IFA$<>"£"THEN150
160 SYS10432
1000 DATA 32,47,72,32,73,72,32,150,72,32,180,72,32,221,72
1010 DATA 32,2,76,32,62,73,32,174,74,32,105,74,32,5,75
1020 DATA 32,96,75,32,105,74,32,88,75,173,9,64,240,230,76
1030 DATA 45,75,169,32,162,0,157,0,4,157,0,5,157,0,6
1040 DATA 157,231,6,202,200,241,142,33,200,142,32,200,96,169,1
1050 DATA 162,40,157,0,216,202,200,250,169,7,162,0,157,0,217
1060 DATA 157,0,218,202,208,247,169,10,162,255,157,231,218,202,208
1070 DATA 250,169,0,162,40,157,40,216,157,192,219,202,208,247,96
1080 DATA 32,32,32,2,2,2,32,32,32,2,2,2,32,32,32
1090 DATA 2,2,2,32,32,32,32,32,40,40,40,40,40,40,32
1100 DATA 162,20,189,120,72,157,32,7,157,52,7,157,72,7,157
1110 DATA 92,7,157,112,7,157,132,7,202,200,232,162,9,189,140
1120 DATA 72,157,0,4,202,208,247,96,169,255,133,86,169,3,133
1130 DATA 87,160,1,162,23,24,165,86,105,40,133,86,165,87,105
1140 DATA 0,133,87,169,23,145,86,202,200,236,96,173,10,64,24
1150 DATA 106,24,106,170,169,160,133,86,169,4,133,87,138,240,17
1160 DATA 24,165,86,105,40,133,86,165,87,105,0,133,87,202,76
1170 DATA 237,72,160,24,169,0,145,86,24,165,86,105,40,133,00
1180 DATA 165,87,105,0,133,09,169,1,145,00,24,165,00,105,40
1190 DATA 133,00,165,89,105,0,133,89,169,0,145,00,24,165,00
1200 DATA 105,40,133,88,165,89,105,0,133,89,169,1,145,00,136
1210 DATA 136,208,197,169,00,133,06,169,4,133,07,160,1,169,63
1220 DATA 141,191,7,24,165,86,105,1,133,06,165,07,105,0,133
1230 DATA 07,177,06,240,7,201,63,208,235,76,160,73,32,135,75
1240 DATA 160,1,169,32,145,06,160,0,177,86,201,5,200,11,160
1250 DATA 1,32,34,75,32,161,75,76,77,73,201,23,200,11,169
1260 DATA 1,160,41,145,86,160,1,76,77,73,169,0,145,86,160
1270 DATA 1,76,77,73,169,32,145,86,160,41,169,1,145,06,160
1200 DATA 1,76,77,73,169,191,133,06,169,7,133,07,160,0,169
1290 DATA 63,141,40,4,56,165,06,233,1,133,86,165,07,233,0
1300 DATA 133,87,177,86,201,1,240,9,201,6,240,09,201,63,200
1310 DATA 229,96,32,135,75,168,0,169,32,145,06,160,1,177,86
1320 DATA 201,5,200,15,169,32,145,06,160,0,32,34,75,32,161
1330 DATA 75,76,103,73,201,63,208,6,169,1,141,9,64,96,201
1340 DATA 23,200,11,169,0,160,39,145,06,160,0,76,103,73,169
1350 DATA 1,145,86,160,0,76,103,73,169,32,145,06,160,40,169
1360 DATA 0,145,06,160,0,32,35,75,76,103,73,169,32,145,06
1370 DATA 160,40,177,86,201,2,200,9,169,3,145,06,160,0,76
1380 DATA 103,73,201,3,200,9,169,4,145,06,160,0,76,103,73
1390 DATA 201,4,200,9,169,32,145,06,160,0,76,103,73,201,7
1400 DATA 200,6,169,1,141,9,64,96,169,6,145,06,160,0,76
1410 DATA 103,73,160,0,177,90,201,5,248,6,169,1,141,6,64
1420 DATA 96,169,32,145,90,56,165,90,233,40,133,90,165,91,233
1430 DATA 0,133,91,24,165,91,105,212,133,89,165,90,133,08,177
1440 DATA 00,208,1,96,177,90,201,32,240,11,32,34,75,32,161
1450 DATA 75,169,32,145,90,96,169,5,145,90,96,169,32,174,0
1460 DATA 64,157,152,7,32,220,255,200,1,96,201,90,240,9,201
1470 DATA 47,240,19,201,32,248,29,96,173,0,64,201,1,200,1
1480 DATA 96,206,0,64,76,36,75,173,0,64,201,38,200,1,96
1490 DATA 230,0,64,76,36,75,173,6,64,208,1,96,24,169,152
1500 DATA 109,8,64,133,90,169,7,105,0,133,91,169,0,141,6
1510 DATA 64,169,5,168,8,145,90,96,141,0,64,142,1,64,140
1520 DATA 2,64,162,128,160,120,136,208,253,202,208,248,173,0,64
1530 DATA 172,2,64,174,1,64,96,96,96,174,0,64,169,7,157
1540 DATA 152,7,96,169,4,141,10,4,141,13,4,169,5,141,11
1550 DATA 4,169,1,141,12,4,165,86,141,32,200,165,87,141,33
1560 DATA 200,230,86,230,87,32,5,75,32,228,255,240,234,76,0
1570 DATA 72,169,42,133,06,169,4,133,07,168,0,140,7,64,24
1580 DATA 165,06,105,1,133,06,165,07,105,0,133,07,177,06,201
1590 DATA 1,240,14,201,0,240,10,201,63,208,229,230,10,64,76
1600 DATA 0,72,96,173,10,200,201,250,176,1,96,160,40,177,06
1610 DATA 201,32,240,3,160,0,96,169,6,145,06,160,0,96,240
1620 DATA 24,173,3,64,105,1,141,3,64,173,4,64,105,0,141
1630 DATA 4,64,173,5,64,105,0,141,5,64,216,173,3,64,106
1640 DATA 106,106,106,24,105,40,141,9,4,173,3,64,41,15,105
1650 DATA 40,141,0,4,173,4,64,106,106,106,106,24,105,40,141
1660 DATA 7,4,173,4,64,41,15,105,40,141,6,4,173,5,64
1670 DATA 106,106,106,106,24,105,40,141,5,4,173,5,64,41,15
1680 DATA 105,40,141,4,4,96,169,0,141,3,64,141,4,64,141
1690 DATA 5,64,141,9,64,141,6,64,141,7,64,141,33,208,141
1700 DATA 32,200,169,12,141,8,64,96,255,255,247,255,-1

READY.
```

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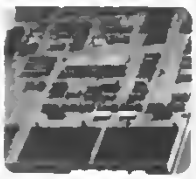
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CS

(continued from page 141)

The results are puzzling at first, but look at it slowly. The pointer will chug along until it finds the first asterisk and it will then move it down one line, a line later it will come across this same asterisk and move it down another line, and another, and another until it comes to the bottom of the screen.

The easiest way to combat this is to scan down the screen if a thing is moving up, and up if it is moving down. This explains why there are two scans. It is these scans which move the invaders and their bullets.

The ship is moved from the keyboard which is a big advantage to those people without a joystick, but a joystick read routine should be quite easy to add.

The input from the keyboard is based upon a routine located at $FFE4 This is a very useful subroutine which is stored in the ROM and used by Basic. When called it looks at the keyboard and return with the keyboard position of the key pressed, or zero if no key is pressed, in the accumulator.

(continued on next page)

```
SYMBOL TABLE

SYMBOL VALUE
 BASE      4AAE     BASE1     4ABC     BASE2     4AL9     BASE2A    4AD1
 BASE3     4AD7     BASE3A    4ADF     BASE4     4AE5     BASE4A    4AEB
 BLEEP     4B22     BLEP      4B21     BLP       4B23     BURD      48BC
 BORD1     48C8     BPLOT     4B24     BUL       4A69     BUL1      005H
 BUL2      005B     BUL3      4A77     BUL4      4A98     BUL5      4AA9
 CLR       482F     CLR1      4833     CMST      D800     COL       4849
 COL1      484D     COL2      4857     COL3      4864     COL4      486L
 DATA      4878     DATA1     488C     DEAD      4B2D     DEAD1     4B3F
 DELAY     4B05     DELAY1    4B10     DELAY2    4B1Z     DIED      4009
 DRAW      4896     DRAW1     4898     DRAW2     48B2     DRINV     48DD
 DRINV1    48ED     DRINV2    4901     DRINV3    4903     FLAG      4006
 FLAG2     4007     FORE      4B87     FORE1     488F     FORE2     4B9A
 IINV      49A8     IINV1     49B7     IINV2     49D3     IINV5     4A27
 IINV4     49F3     IINV5     49FD     IINV6     4A15     IINV7     4A3C
 IINV8     4A49     IINV9     4A56     IINVA     4A60     IJNV3     4990
 IJNV5     4A0C     INV       493E     INV1      494D     INV2      4965
 INV3      4981     INVA      4999     MAIN      4800     MAIN1     481z
 OVER      4B58     OVER1     4B65     OVER2     4B86     PLOT      0056
 PLOT2     0058     PLOTT     0057     PLOTT2    0059     POS       4008
 RAND      D012     RESET     4C02     SCOR4     4005     SCOR5     40U4
 SCOR6     4003     SCORE     4BA1     SCST      0400     SHEET     400H
 TEMPA     4000     TEMPX     4001     TEMPY     4002
```

Listing 2

```
LINE# LOC  CODE        LINE

00001  0000                    PUT "0 INV.13"
00002  0000                    .
00003  0000                    ;*************************
00004  0000                    ; == BASIC SPACE INVADERS ==
00005  0000                    ;*************************
00006  0000                    .
00007  0000                    ;WRITTEN FOR THE COMMODORE 64
00008  0000                    ;BUT WILL RUN ON MOST 6502
00009  0000                    ;BASED MACHINES WITH VERY LITTLE
00010  0000                    ;ADAPTIONS
00011  0000                    .
00012  0000                    .
00013  0000                    ;START LINE CODE AT 4B4096
00014  0000                    .
00015  0000                            *=B4000
00016  4800                    .
00017  4800                    ;VARIABLES
00018  4800  20        TEMPA   BYT 0
00019  4801  00        TEMPX   BYT 0
00020  4802  00        TEMPY   BYT 0
00021  4803  00        SCOR6   BYT 0
00022  4804  00        SCOR5   BYT 0
00023  4805  00        SCOR4   BYT 0
00024  4806  00        FLAG    BYT 0
00025  4807  00        FLAG2   BYT 0
00026  4808            PLOT    = $58
00027  4808            PLOTT   = $57
00028  4808            PLOT2   = $59
00029  4808            PLOTT2  = $59
00030  4808            BUL1    = $5B
00031  4808            BUL2    = $5B
00032  4808  0C        POS     BYT 12
00033  4809  00        SHEET   BYT 0
00034  480A            SCST    = 1024
00035  480A            CMST    = $D296
00036  480A            RAND    = $D240+10 ;RASTER REGISTER
00037  480A  00        SHEET   BYT 0
00038  480B                    .
00039  480B                    ;HERE IS THE MAIN ROUTINE WHICH
00040  480B                    ;CALLS ALL OF THE OTHER
00041  480B                    ;SUB-ROUTINES
00042  480B                    .
00043  480B                    .
00044  480B                            *=B4800
00045  4800                    .
00046  4800                    .
00047  4800  00 2F 48  MAIN    JSR CLR         CLEAR SCREEN
00048  4803  00 49 48          JSR COL         COLOR SCREEN
00049  4806  00 00 48          JSR DRAW        DRAW  SCREEN
00050  4809  20 BC 48          JSR BORD        DRAW  BORDERS
00051  480C  00 3D 49          JSR DRINV       DRAW  INVS
00052  480F  20 02 4C          JSR $0B01       $0B01 SCORE BTC
00053  4812                    .
00054  4812                    ;THE SCREEN SHOULD NOW BE DEFINED
00055  4812                    .
00056  4812  20 00 49  MAIN1   JSR INV         MOVE INVS
00057  4815  20 00 4A          JSR BASE        MOVE BASE
00058  4818  20 69 4A          JSR BUL         MOVE BULLET
00059  481B  00 B5 49          JSR DELAY       ;SLOW DOWN
00060  481E  20 24 4B          JSR BPLOT       ;DRAW BASE
00061  4821  00 69 4A          JSR BUL         ;ANY BULLETS
00062  4824  20 58 49          JSR OVER        CHECK FOR END
00063  4827                    .
00064  4827                    ;NOW TO CHECK IF ONE IS DEAD
00065  4827                    ;IF SO THEN FLAG DIED = 1
00066  4827                    ;IF NOT THEN DIED = 0
00067  4827                    .
00068  4827  AD 08 48          LDA $1ED
00069  4830  F0 B6             BEQ MAIN1
00070  4832                    .
00071  4832                    ;IF THE PROGRAM DATA HERE THEN
00072  4832                    ;YOU HAVE $1ED
00073  4832                    .
00074  4832  4C 00 49          JMP DEAD
00075  4835                    .
00076  4835                    .
00077  4835                    ;***** CLEAR SCREEN *****
00078  4835                    .
00079  4835  A9 00     CLR     LDA #32         CHR$ SPACE
00080  4837  A2 00             LDX #0          COUNTER +256
00081  4839  9D 00 04  CLR1    STA SCST,X      STORE SPACE
00082  483C  9D 00 05          STA SCST+$50,X  OVER THE SCREEN
00083  483F  9D 00 06          STA SCST+$1L2,X MEMORY
00084  4842  9D E7 06          STA SCST+$3E7,X
00085  4845  CA                DEX             IFX<0THEN
00086  4846  D0 F1             BNE CLR1        REPEAT
00087  4848  8E 21 D0          STX $D021       SCREEN BLACK
00088  484B  8E 20 D0          STX $D020       BORDER BLACK
00089  484E  60                RTS
00090  484F                    .
00091  484F                    .
00092  484F                    .
00093  484F                    ;***** COLOUR SCREEN *****
00094  484F                    .
00095  484F  A9 01     COL     LDA #1          WHITE
00096  4851  A2 00             LDX #00         1 LINE
00097  4853  9D 00 D8  COL1    STA CMST,X      SCORE IS WHITE
00098  4856  CA                DEX
00099  4857  D0 FA             BNE COL1
00100  4859                    .
00101  4859  A9 07             LDA #           ;YELLOW
```

```
00102  485B  A2 00             LDX #00         256
00103  485D  00 00 00  COL4    STA CMST+$50,X  MIDDLE SCREEN
00104  4860  9D 00 DA          STA CMST+$1L2,X IS YELLOW
00105  4863  CA                DEX
00106  4864  D0 F7             BNE COL2
00107  4866                    .
00108  4866  A9 0A             LDA #10         LT RED
00109  4868  A2 FF             LDX #255
00110  486A  9D 27 00  COL3    STA CMST+40,X   ;FOR 1L RED
00111  486D  CA                DEX
00112  486E  D0 F8             BNE COL3
00113  4870                    .
00114  4870  A9 00             LDA #0          BLACK
00115  4872  A2 28             LDX #40
00116  4874  8E 4C 0F  COL4    STA CMST+40,X   SECOND TO TOP
00117  4877  E0 C0 00          STA CMST+$3B0,X ;AND LAST LINE
00118  487A  CA                DEX
00119  487B  D0 F7             BNE COL4
00120  487D                    .
00121  487D                    .
00122  487D  60                RTS
00123  487E                    .
00124  487E                    ;***** DRAW IN SCREEN *****
00125  487E                    .
00126  487E  20        DATA    BYT 32 3C 32 2 2 2 2 32 32 32 2
       ,2 3C 32 3, 2 32 32
00126  4879  20
00126  487A  20
00126  487B  0A
00126  4U   4U
00126  487D  00 D
00126  487E  00
00126  487F  00
00126  4800  20
00126  4801  0A
00126  4802  0A
00126  4803  0A
00126  4804  20
00126  4805  20
00128  4806  20
00128  4807  02
00126  4808  02
00126  4809  02
00126  480A  20
00126  480B  20
00127  480C  20        DAT01   BYT 32 3C 32 40 40 40 40 40 40 3C
00127  480D  00
00127  480E  20
00127  480F  30
00127  4810  30
00127  4811  30
00127  4812  30
00127  4813  30
00127  4814  30
00127  4815  00
00128  4816                    .
00129  4816                    .
00130  4816  A2 14     DRAW    LDX #20         00 BYTES
00131  4818  A9 00     DRAW1   LDA DAT0,X      BUNKERS
00132  481A  9D 28 07          STA SCST+$000,X
00133  481D  9D 40 07          STA SCST+$040,X
00134  4820  9D 5C 07          STA SCST+$080,X
00135  4823  9D 78 07          STA SCST+$0C0,X
00136  4826  9D 94 07          STA SCST+$100,X
00137  4829  CA                DEX
00138  482A  00 E9             BNE DRAW1
00139  482C                    .
00140  482C  A0 00             LDY #9          9 BYTES
00141  482E  B9 BC 48  DRAW2   LDA DAT01,X     SCORE
00142  4831  99 00 04          STA SCST,Y
00143  4834  CA                DEX
00144  4835  00 F7             BNE DRAW2
00145  4837  60                RTS
00146  4838                    .
00147  4838                    .
00148  4838                    ;***** DRAW BORDER *****
00149  4838                    .
00150  4838  A9 FF     BORD    LDA #$FF        PLOT=$0000
00151  483A  85 58             STA PLOT        THE START OF
00152  483C  A9 03             LDA #$02        THE COLOUR
00153  483E  85 57             STA PLOTT       SCREEN
00154  4840  A2 01             LDX #1
00155  4842  A0 17             LDY #23         23 LINES
00156  4844                    .
00157  4844  18        BORD1   CLC
00158  4845  A5 58             LDA PLOT        PLOT=PLOT+40
00159  4847  69 28             ADC #40
00160  4849  85 58             STA PLOT
00161  484B  A5 57             LDA PLOTT
00162  484D  69 00             ADC #0
00163  484F  85 57             STA PLOTT
00164  4851                    .
00165  4851  88 17             LDY #23         MARKER
00166  4853  91 58             STA (PLOT),Y PUT COL ON LEFT
00167  4855  CA                DEX             OF THE SCREEN
00168  4856  D0 EC             BNE BORD1
00169  4858  60                RTS
00170  4859                    .
00171  4859                    .
00172  4859                    .
00173  4859                    ;***** DRAW INVADERS *****
00174  4859  A0 00 00  DRINV   LDA SHEET
00175  485C  18                CLC
00176  485D  6A                ROR A
00177  485E  18                CLC             $1=IBR BY 4
00178  485F  6A                ROR A           X=0
00179  4860  AA                TAX
```

```
00180  4861
00181  4863  A9 00             LDA #160
00182  4865  8D 56 00          STA PLOT        PLOT=6 LINES
00183  4867  A9 04             LDA #04         DOWN THE
00184  4869  85 57             STA PLOTT       SCREEN
00185  486B                    .
00186  486B  A0 00     DRINV1  LDY #0          ;0=Y
00187  486D  F0 11             BEQ DRINV2
00188  486E                    CLC
00189  486F  A5 56             LDA PLOT
00190  4871  69 28             ADC #40         MOVE DOWN
00191  4873  85 56             STA PLOT        1 LINE
00192  4875  A5 57             LDA PLOTT
00193  4877  69 00             ADC #0
00194  4879  85 57             STA PLOTT
00195  487B  C8                DEY
00196  487C  4C E0 48          JMP DRINV1
00197  487F
00198  4881                    .
00199  4881                    ;WHERE TO START PLOTTING THE INVADERS
00200  4881                    ;IS NOW STORED IN PLOT & PLOT+
00201  4881                    .
00202  4881  A0 18     DRINV2  LDY #24         ;24 PER LINE
00203  4883  A9 00     DRINV3  LDA #0
00204  4885  91 56             STA (PLOT),Y    LINE 1
00205  4887  18                CLC
00206  4888  A5 56             LDA PLOT
00207  488A  69 28             ADC #40
00208  488C  85 58             STA PLOT+2
00209  488E  A5 57             LDA PLOTT
00210  4890  69 00             ADC #0
00211  4892  85 59             STA PLOTT+2
00212  4894  A9 01             LDA #1
00213  4896  91 56             STA (PLOT),Y    LINE2
00214  4898
00215  4898  18                CLC
00216  4899  A5 58             LDA PLOT+2
00217  489B  69 28             ADC #40
00218  489D  85 58             STA PLOT+2
00219  489F  A5 59             LDA PLOTT+2
00220  48A1  69 00             ADC #0
00221  48A3  85 59             STA PLOTT+2
00222  48A5  A9 01             LDA #1
00223  48A7  91 56             STA (PLOT+2),Y  LINE3
00224  48A9
00225  48A9  18                CLC
00226  48AA  A5 58             LDA PLOT+2
00227  48AC  69 28             ADC #40
00228  48AE  85 58             STA PLOT+2
00229  48B0  A5 59             LDA PLOTT+2
00230  48B2  69 00             ADC #0
00231  48B4  85 59             STA PLOTT+2
00232  48B6  A9 01             LDA #1
00233  48B8  91 56             STA (PLOT+2),Y  LINE4
00234  48BA
00235  48BA  A0                LDY             REPEAT FOR 12
00236  48BC  00                BRK             INVS PER LINE
00237  48BD  00 C6             BNE DRINV3
00238  48BF
00239  48BF                    .
00240  48BF                    ;*** MOVE ALL 4 INV *****
00241  48BF
00242  48BF  A9 30             LDA #48
00243  48C1  85 5A             LDX #04
00244  48C3  A2 04             STA PLOTT       ;= 1 LINE LO
00245  48C5  85 57             LDY #1          ;= BE IN SCRST
00246  48C7  A0 01             RTS             ;RIGHT
00247  48C9  60
00248  48CA  A9 03 8D 07 D0     STA 1003
00249  48CF  A9 00
00250  48D1  A9 00     INV1    CLC             WORK DOWN
00251  48D3  18                LDA PLOT        THE SCREEN
00252  48D4  69 01             ADC #1          ONE(X)NO
00253  48D6  85 58             STA PLOT        FOR 0 9
00254  48D8  A5 57             LDA PLOTT
00255  48DA  69 00             ADC #0
00256  48DC  85 57             STA PLOTT
00257  48DE  A1 56             LDA (PLOT),Y
00258  48E0  C9 3F             CMP #63         ;FOUND ONE
00259  48E2  D0 03             BNE INV1        ;INISHED
00260  48E4  4C 00 49          JMP $1INV
00261  48E7
00262  48E7
00263  48E7
00264  48E7  A0 07     INV2    LDY #7          ;00 FORE
00265  48E9  A9 31             LDA #31
00266  48EB  A0 00             LDY #0          BLANK OUT
00267  48ED  91 56             STA (PLOT),Y INVADER
00268  48EF
00269  48EF  A0 00             LDY #0
00270  48F1  B1 56             LDA (PLOT),Y WHERE TO GO
00271  48F3
00272  48F3  C9 00             CMP #0          BULLET ?
00273  48F5  D0 08             BNE INV3
00274  48F7  A9 01             LDA #1
00275  48F9  20 22 4B          JSR BLEEP
00276  48FC  20 A1 48          JSR SCORE
00277  48FF  4C 43 49          JMP INV1
00278  4902
00279  4902  C9 17     INV3    CMP #23         ;@1BR OF THE
00280  4904  B0 08             BNE INV3        SCREEN
00281  4906  A9 01             LDA #1
00282  4908  91 56             STA (PLOT),Y
00283  490A  88 01             LDY #1
```

(listing 2 continued on next page)

(continued from previous page)

The only real problem left is scoring. As this has all been dealt with before, suffice to say that a simple counter is being used in the top left corner of the screen.

Although the program contains very few frills, it is still very long . . . do not forget to Save it before running it. The graphics have not actually been defined, but here are the character numbers and their use if you want to add your own.

Character number	Use
0	Invader (right to left)
1	Invader (left to right)
2	base defense (not hit)
3	base defence (hit once)
4	base defence (hit twice)
5	bullet going up
6	bullet going down
7	base ship
23	marker (should be blank)
32	space
48-58	numbers
63	marker (should be left blank)

The characters d, e and a should be defined for the word "Dead". Happy adapting and have fun with the graphics. ■

6502 MACHINE CODE MADE EASY



(listing 2 continued from previous page)

```
4B8D  4C 40 49          JMP INV1
4B05
4B05  A9 30     IJNV3   LDA 60
4992  91 56             STA (PLOT),Y
4B04  A0 01             LDY R1
4996  4C 40 49          JMP INV1
4B05
4B05  A9 02     INVA    LDA #32
4998  91 30             STA (PLOT),Y
4B00  A0 29             LDY 041
499F  A9 01             LDA 01
49A1  91 30             STA (PLOT),Y
49A3  A0 01             LDY 01
49A5  4C 40 49          JMP INV1
4940
4948
49AE
49AE
                ;===== MOVE ALL 1 INVADERS =====
49A8  A9 BF     IINV    LDA 00BF        ,ONE LINE UP
49AA  85 56             STA PLOT
49AC  A9 07             LDA R7
49A0  85 57             STA PLOTT
49B0  A0 30             LDY 30
49B2  A9 3F             LDA 063         MARKER AT TOP
49B4  80 05 04          STA 1004        LEFT
4887
4887  38        IINV1   SEC
4900  A5 30             LDA PLOT        ,UP THE SCREEN
4900  E9 01             SBC 01          ,ONE SPACE AT
49BC  85 30             STA PLOT        ,A TIME
4940  A5 97             LDA PLOTT
49C0  E9 30             SBC 30
49C2  85 97             STA PLOTT
49C4  B1 56             LDA (PLOT),Y
49C8  C9 01             CMP R1          ,INVADER RIGHT
49C8  F0 08             BEQ IINV3
49CA  C9 30             CMP 00          BULLET DOWN
49CC  F0 59             BEQ IINV3
49CE  C9 3F             CMP 063
4900  D0 09             BNE IINV1
4902  40                RTS
4903
4803
4932  20 87 40  IINV2   JSR FORE
49D6  A0 30             LDY 30
49D0  A9 20             LDA 032         BLANK OUT
49DA  81 30             STA (PLOT) Y    INV.
49DC  A0 01             LDY R1          WHERE TO GO
49DE  B1 56             LDA (PLOT),Y
49E0  C9 05             CMP 05          ,BULLET ?
49E2  D0 0F             BNE IINV4
4484  A9 20             LDA 032
49E4  91 56             STA (PLOT),Y
49E8  A0 30             LDY 00
49EA  20 22 40          JSR SLEEP
49E8  20 A1 40          JSR SCORE
49F0  4C 07 40          JMP IINV1
49F3
49F3  C9 3F     IINV4   CMP 063         HAVE THEY
49F5  D0 06             BNE IINV5       LANDED ?
49F7  A9 01             LDA 01
49F9  80 00 40          STA DIED
49FC  40                RTS
49FD
49FD  C9 17     IINV5   CMP R23         EDGE
49FF  D0 08             BNE IJNV5
4A01  A9 00             LDA 30
4A03  A0 27             LDY R03
4A05  91 54             STA (PLOT),Y
4407  A0 00             LDY 00
4409  4C 07 49          JMP IINV1
4ABC
4ABC  A9 01     IJNV5   LDA 01
440E  91 56             STA (PLOT),Y
4A10  A0 00             LDY 00
4A12  4C 07 49          JMP IINV1
4A15
4A15  A9 20     IINV6   LDA 032         EDGE
4A17  91 56             STA (PLOT),Y    BLANK OUT
4A19  A0 28             LDY #40         INV CHANGE
4A1B  A9 00             LDA #0          DIRECTION
4A1D  91 56             STA (PLOT),Y    REPLOT IT
4A1F  A0 00             LDY R0
4A21  20 23 40          JSR BLP         BLEEP
4A24  4C 07 49          JMP IINV1       NEXT PLEASE
4A27
4A27  A9 20     IINV7   LDA 032
4A29  91 56             STA (PLOT),Y
4A2B  A0 28             LDY #40         ONE LINE
4A2D  B1 56             LDA (PLOT),Y    DOWN
4A2F  C9 02             CMP 02          BUNKER
4A31  D0 09             BNE IINV7
4A33  A9 03             LDA 03          DECOMPOSE
4A35  91 56             STA (PLOT),Y    IT
4A37  A0 00             LDY 00
4A39  4C 07 49          JMP IINV1
4A3C
4A3C  C9 03     IINV7   CMP 03          BUNKER
4A40  D0 09             BNE IINV8
4A40  A9 04             LDA 04
4A42  91 30             STA (PLOT),Y
4A44  A0 00             LDY 00
4A46  4C 07 49          JMP IINV1
4A49
4A49  C9 04     IINV8   CMP 04
4A4B  D0 09             BNE IINV9
4A4D  A9 20             LDA R32
4A4F  91 56             STA (PLOT),Y
4A51  A0 30             LDY R0
4A53  4C 07 49          JMP IINV1
4A56
4A58  C9 07     IINV9   CMP 07
4A5A  D0 08             BNE IINVA
4A5A  A9 01             LDA 01
4A5C  8D 03 30          STA DIED
4A5F  40                RTS
4A60
4A60  A9 30     IINVA   LDA 05
4A62  91 30             STA (PLOT),Y
4A64  A0 00             LDY 00
4A66  4C A7 49          JMP IINV1
4409
4A68
4A69
4403
                ===== MOVE THE BULLET UP =====
4A69  A0 30     BUL     LDY 30          HAS THE
4A6B  B1 5A             LDA (BUL1) Y    BULLET BEEN
440D  C9 05             CMP 05          HIT ?
4A6F  F0 30             BEQ BUL3        NO
4A71  A9 01             LDA 01          SET
4A73  80 30 30          STA FLAG        FIRE FLAG
4A78  30                RTS
4A77
4A77  A9 20     BUL3    LDA 032
4A79  91 BA             STA (BUL1) Y
4A7B  38                SEC
4A7C  A5 BA             LDA BUL1        ,MOVE BULLET
4A7E  E9 05             SBC 040         UP
4A80  85 BA             STA BUL1
4A82  A5 5B             LDA BUL2
4A84  E9 00             SBC 00
4A86  85 5B             STA BUL2
4A68
4A88  18                CLC
4A89  A5 5B             LDA BUL2        TOP OF
4A8B  69 04             ADC 0004        SCREEN
4A8D  85 59             STA PLOTT2      IS BLANK
4A8F  A5 BA             LDA BUL1        IF SO
4A91  85 30             STA PLOT2       THEN
4A93  B1 30             LDA (PLOT2) Y   RETURN
4A95  D0 01             BNE BUL4
4A97  40                RTS
4A98
4A98  B1 BA     BUL4    LDA (BUL1) Y    WHATS
4A9A  C9 30             CMP 032         THERE
4A9C  F0 08             BEQ BUL5
4A9E  20 22 40          JSR SLEEP
4AA1  20 A1 40          JSR SCORE
4AA4  A9 20             LDA 032         REPLOT
4AA6  91 BA             STA (BUL1) Y
4AA8  40                RTS
4AA9
4AA9  A9 05     BUL5    LDA 05
4AAB  91 5A             STA (BUL1) Y
4AAD  40                RTS
4AAE
4AAE
4AAE
4AAE
4AAE
                ===== MOVE THE BASE =====
4AAE  A9 20     BASE    LDA 032
4AB0  AE 06 40          LDX POS
4AB3  9D 98 07          STA 1024+920
4AB6
4AB8  20 E4 FF          JSR $FFE4       CHECK KEYBOARD
4AB9  D0 01             BNE BASE1       KEY PUSHED
4ABB  60                RTS             NOT PRESSED
4ABC
4ABC  C9 BA     BASE1   CMP 090
4ABE  F0 05             BEQ BASE2       Z   -LEFT
4AC0  C9 2F             CMP 047
4AC2  F0 13             BEQ BASE3           -RIGHT
4AC4  C9 20             CMP 032
4AC6  F0 1D             BEQ BASE4       SPACE -FIRE
4AC8  40                RTS
4AC9
4AC8  AD 06 40  BASE2   LDA POS         BASE POS IN
4ACC  C9 01             CMP 01          ALREADY LEFT
4ACE  D0 01             BNE BASE2A      ??
4AD0  60                RTS
4AD1
4AD1  CE 00 00  BASE2A  DEC POS         POS=POS-1
4AD4  4C 24 40          JMP BPLOT       PLOT BASE
4AD7
4AD7  AD 00 40  BASE3   LDA POS
4ADA                    CMP #           RIGHT?
4ADC  D0 01             BNE BASE3A      NO
4ADE  40                RTS
4ADF
4ADF  EE 30 30  BASE3A  INC POS         POS=POS+1
4AE2  4C 24 40          JMP BPLOT
4AE5
4485  A1 00 40  BASE4   LDA FLAG
4A60  D0 01             BNE BASE4A      CAN FIRE
4A6A  40                RTS
4A68
4A68  18        BASE4A  CLC
4A6C  A9 30             LDA #920        BUL
4A6E  6D 00 40          ADC POS         =
4AF1  85 5A             STA BUL1        POS+LINE
4AF3  A9 07             LDA 007         POSITION
4AF5  69 30             ADC 00
4AF7  85 90             STA BUL2
4AF9  A9 00             LDA 00
4AFB  8D 30 40          STA FLAG
4AFE  A9 05             LDA 05          PLOT BULLET
4B06  A0 00             LDY 00
4B02  91 5A             STA (BUL1) Y
4B04  60                RTS
4B05
4B05
4B05
4B05
                ====== DELAY =====
4B05  8D 00 40  DELAY   STA TEMPA       SAVE REGISTERS
4B05  8E 01 40          STX TEMPX
4B08  8C 02 40          STY TEMPY
4B05
4B0E  A2 00             LDX 0120        DELAY SUB.
4B10  A0 00     DELAY1  LDY R120
4B12  88        DELAY2  DEY
4B13  D0 FD             BNE DELAY2
4B15  CA                DEX
4B16  D0 F8             BNE DELAY1
4B18
4B18  AD 00 40          LDA TEMPA RE-LOAD REGISTERS
4B1B  AC 02 40          LDY TEMPY
4B1E  AE 01 40          LDX TEMPX
4B21
4B21  60        BLEP    RTS             THE SOUND IS FOR YOU
4B22  60        BLEEP   RTS             TO TRY/ADD ONE OF
4B23  60        BLP     RTS  .THE ROUTINES USED EARLIER
4B24
4B24
4B24
                ===== PLOT THE BASE =====
                ;
4B24  AE 00 60  BPLOT   LDX POS
4B27  A9 07             LDA 07
4B29  9D 00 07          STA 1024+920 X
4B2C  60                RTS
4B2D
4B2D                    ;
4B2D                    ;
4B2D                    ;===== DEAD =====
4B2D
4B2D                    ;HERES THE PLACE TO PUT A TUNE
4B2D                    ;(EV. DEATHMARCH) IF YOU WANT TO
4B2D                    ;
4B2D  A9 04     DEAD    LDA 04
4B2F  8D 0A 04          STA 1024+10
4B32  8D 0D 04          STA 1024+13
4B35  A9 05             LDA 05
4B37  8D 0B 04          STA 1024+11
4B3A  A9 01             LDA R1
4B3C  8D 0C 04          STA 1024+12
4B3F
4B3F  A5 56     DEAD1   LDA PLOT
4B41  8D 00 D0          STA 53280
4B44  A5 57             LDA PLOTT
4B46  8D 21 D0          STA 53281
4B49  E6 56             INC PLOT
4B4B  E6 97             INC PLOTT
4B4D  20 05 4B          JSR DELAY
4B50  20 E4 FF          JSR $FFE4
4B53  F0 EA             BEQ DEAD1
4B55
4B55  4C 00 40  ;       JMP MAIN
4B58
4B58            ;
4B58            ;
4B58            ;===== BOS ALL INVS GONE =====
4B58            ;
4B58  A9 BA     OVER    LDA 042
4B5A  85 30             STA PLOT
4B5C  A9 04             LDA 04
4B5E  85 97             STA PLOTT
4B60  A0 30             LDY 00
4B63  8C 07 30          STY FLAG2
4B65
4B66  18        OVER1   CLC
4B66  A5 56             LDA PLOT
4B68  69 01             ADC 01
4B6A  85 56             STA PLOT
4B6C  A5 97             LDA PLOTT
4B6E  69 30             ADC 00
4B70  85 57             STA PLOTT
4B72  B1 30             LDA (PLOT) Y
4B74  C9 01             CMP 01
4B76  F0 08             BEQ OVER2
4B78  C9 00             CMP 00
4B7A  F0 BA             BEQ OVER2
4B7C  C9 3F             CMP 063
4B7E  D0 E5             BNE OVER1
4B80  EE BA 40          INC SHEET
4B83  4C 30 30          JMP MAIN
4B86
4B86  60        OVER2   RTS
4B87            ;
4B87
4B87             ===== INVADER FIRE =====
4B87
4B87  AD 12 30  FIRE    LDA RAND        RANDOM NUMBER
4B8A  C9 FA             CMP 0250        FIRE RATE
4B8C  B0 01             BCS FIRE1
4B8E  40                RTS
4B8F
4B8F  A0 28     FIRE1   LDY #40
4B91  B1 56             LDA (PLOT),Y
4B93  C9 30             CMP 032
4B95  F0 03             BEQ FORE2
4B97  A0 00             LDY 00
4B99  60                RTS
4B96
4B9A  A9 30     FORE2   LDA 08
4B9C  91 56             STA (PLOT),Y
4B9E  A0 00             LDY 00
4BA0  60                RTS
4BA1
4BA1
4BA1
4BA1             ===== SCORE ROUTINE =====
4BA1            ;
4BA1  F8        SCORE   SED
4BA2  18                CLC
4BA3  AD 03 30          LDA SCOR6       ,ADD 1 TO THE
4BA6  69 01             ADC 01          ,SCORE
4BA8  8D 02 40          STA SCOR6
4BAB  AD 04 40          LDA SCOR6       ,CHECK FOR THE
4BAE  69 00             ADC 00          ,CARRY BIT
4BB0  8D 04 30          STA SCOR5
4BB2  AD 05 30          LDA SCOR4       ,AND ROR1A
4BB6  69 00             ADC 00
4BB8  8D 05 40          STA SCOR4
4BBB  D8                CLD
4BBC
4BBC            THE SCORE HAS NOW BEEN INCREMENTED
4BBC            ,NOW DISPLAY IT
4BBC            ;
4BBC  AD 03 30          LDA SCOR6
4BBF  6A                ROR A           ,BLANK OUT LEAST SIG. NIBBLE
4BC0  6A                ROR A
4BC1  6A                ROR A
4BC2  6A                ROR A
4BC3  18                CLC
4BC4  69 30             ADC 006         ,CONVERT TO ASCII
4BC6  8D 08 04          STA SCST+8
4BC9  AD 03 40          LDA SCOR6       GET LEAST SIG. NIBBLE
4BCC  29 0F             AND 015
4BCE  69 30             ADC 048         CARRY BIT MUST BE 0
4BD0  8D 08 04          STA SCST+8
4BD3
4BD3  AD 04 40          LDA SCOR5
4BD6  6A                ROR A
4BD7  6A                ROR A
4BD8  6A                ROR A
4BD9  6A                ROR A
4BDA  18                CLC
4BDB  69 30             ADC 048
4BDD  8D 07 04          STA SCST+7
4BE0  AD 04 40          LDA SCOR5
4BE3  29 0F             AND R15
4BE5  69 30             ADC 006
4BE7  8D 08 04          STA SCST+6
4BEA
4BEA  AD 05 40          LDA SCOR4       REPEAT FOR
4BED  6A                ROR A           THE OTHER
4BEE  6A                ROR A           DIGITS
4BEF  6A                ROR A
4BF0  6A                ROR A
4BF1  18                CLC
4BF2  69 30             ADC 006
4BF4  8D 05 04          STA SCST+5
4BF7  AD 05 40          LDA SCOR4
4BFA  29 0F             AND 015
4BFC  69 30             ADC 048
4BFE  8D 04 04          STA SCST+4
4C01
4C01            THE SCORE IS NOW ON THE SCREEN
4C01
4C01  60                RTS
4C02
4C02
4C02            ===== RESET SCORE ,FLAGS ETC =====
4C02  A9 30     RESET   LDA 00
4C04  8D 03 40          STA SCOR6       SCOR = 0
4C07  8D 04 40          STA SCOR5
4C0A  8D 05 40          STA SCOR4
4C0D  8D 00 40          STA DIED        ALIVE AGAIN
4C10  8D 06 40          STA FLAG
4C13  8D 07 40          STA FLAG2       CAN FIRE
4C16  8D 21 D0          STA 53281       BLACK ON
4C19  8D 20 D0          STA 53280       BLACK
4C1C  A9 0C             LDA 012
4C1E  8D 05 40          STA POS         MIDDLE OF SCREEN
4C21  60                RTS
4C22
4C22
4C22
4C22
4C22                    .END
```

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GIANT TEST VIC COMPUTING
(Vol. 2 Issue 5 June, '83)

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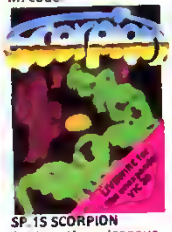
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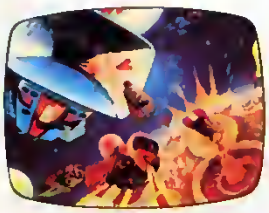


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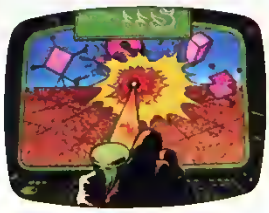
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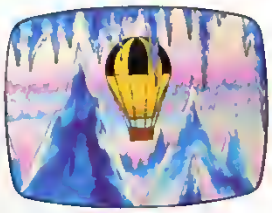


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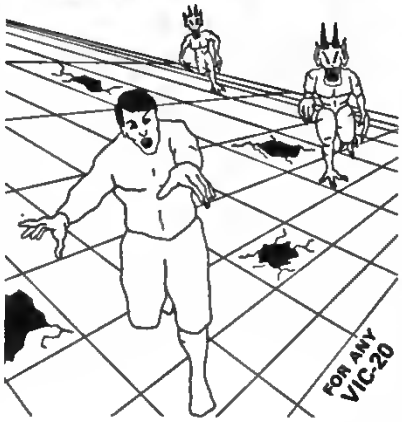
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Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

GUARANTEE

■ **Last November I purchased a 16K Spectrum. I found this very useful but as I progressed I found that the 9K RAM available to the user was insufficient for larger programs and databases. I have seen various advertisements for upgrades to 48K for far less than the £60 Sinclair upgrade. I have been led to believe that installation of such an upgrade requires the machine to be taken apart. Does this void the Sinclair guarantee, and if so, do the companies selling such upgrades offer their own guarantee? Are the upgrades easy to fit or do you have to send in your Spectrum for fitting?**

P Crawley,
Bucknell, Salop.

AS FAR AS I can determine, only one company — Kempstone — claims its memory upgrade will not void the guarantee. You are right in saying the machine must be taken apart to fit the unit. The vast majority of companies selling the upgrade units provide a fitting service. Functionally, there is no difference between a Sinclair memory upgrade, and a non-Sinclair one. You may well find that the Microdrive is more use to you for database programs and may therefore prefer to save your money for the drive.

A GOOD BUY

■ **I wish to buy a computer for around £400 or less which will be used predominately for word-processing. Which one is the best to get?**

Vince Gifford,
Hastings, East Sussex.

THERE ARE several computers in the price range you mention which provide you with serviceable word-processing capabilities. The main things to look for are a "proper" keyboard, that is, one which is like a typewriter keyboard and a word-processing program for that machine. Both these pretty obvious conditions must be met. There are several computers which have word processor programs available, but have keyboards which do not sustain long term typing and could not support touch typing. As well, if you are interested in writing long sections of text — as opposed to, say, two and three page letters — you will need text storage and for practical use, this should be on disk. However, adding disks will move the cost of the computer out of the range you specify. The BBC Micro is one machine you should consider. Both the BBC's word processing programs View and Wordwise are available in ROM — View is £52, Wordwise is £34.50! Having a program in ROM means it is always available, simply by typing in a command. Gemini Marketing, 03952-5832, is one of many other companies which provides a word processing package for the BBC Micro. Its program, which is designed primarily for letter-writing, is £19.95. The Dragon is also worth considering, as it has a fairly good keyboard. The Vic-20 has a good keyboard, a choice of several word processing programs, but its coarse screen — 23 characters across — is seen by many as a disadvantage for word processing.

NO POINT

■ **Could you please explain why the Point instruction does not work while using Print statements on our BBC Micro Model B with 1.2 operating system and did not work when we had the 0.1 OS either? I find this problem irritating as I feel there is probably some way of making it work.**

Colin MacDonald,
Bothwell, Glasgow.

THE ONLY reason I can imagine for it not appearing to work is that you are trying to use it in mode 7 — it only works in modes 0 to 6 — and that you are trying to get it to work with Print Tab co-ordinates. Point co-ordinates start in the bottom left hand corner of the screen. The grid is from 0 to 1023 and from 0 to 1279.

ZX-81 KEYBOARD

■ **I am a ZX-81 owner. I am considering purchasing a full-size keyboard for my machine. I would like this keyboard to have repeat facilities and possibly single-key Edit, Function, Rubout and the like. The choice on the market is bewildering. However, the keyboard I am most interested in, from Harris and Lockyer Associates, will not fit the ZX-81 PCB inside. This is annoying beeause if I am going to buy other add-ons which fit on the edge connector — my ZX-81 is tilted at an angle to let the heat out — the weight of them, as they are not resting on the table, will probably either break them or cause a whiteout when they wobble. What keyboard should I buy?**

David Wilding,
London, N16.

THE CHOICE problem has been compounded by your decision to have the computer at an angle. I use an extension keyboard on a desk. Above the desk is a small shelf which is not connected to the desk. The ZX-81, RAMpack and the rest, sit on this shelf. The ZX-81 is raised slightly off the shelf, held at the edges, to allow heat to escape. However, it is not tilted, but stands parallel to the shelf. I have a large bulldog clip holding the cable onto the edge of the shelf between the computer and the keyboard. This means that even if I knock the keyboard, this is not transmitted to the computer. There are several suitable keyboards on the market, any of which should serve you well. Certainly, we have not heard about recurrent problems with any brand. Simplify your choice by realising you do not have the ZX-81 on an angle.

ANIMATION

■ **I own a 16K ZX Spectrum which I have found is not very good for some kinds of high-resolution animated graphics. The BBC's VDU 19 command seems to help here. I was wondering if there was any routine which I could use to emulate this?**

Alan Thompson,
Asham, Penrith.

I DO NOT know of any 'pre-potted' routine to carry out VDU 19's function. You can easily change the whole background colour of the Spectrum screen without disturbing what is on it, by declaring an array 704 characters long, thus:

DIM A$(704)),

then printing this At 0, 0 prefaced by Over 1. Putting graphics within strings, and then manipulating them by string-slicing is the simplest and, in many cases, the fastest way to get moving graphics on the Spectrum in Basic. If you wish to progress into machine code, and create your own VDU 19, there are a number of books which could help you, including *Machine Language Made Simple on the Spectrum* by Tang, *Mastering Machine Code on the ZX Spectrum* by Baker, and *Spectrum Machine Code Made Easy*, books one and two, Holmes and Walsh.

LYNX QUERY

■ **As a present ZX-81 owner, I am contemplating upgrading to a more advanced machine. The computer I have in mind is the Lynx but I have one grave misgiving about the machine — it only handles single statement lines. My question is: can the machine be made to handle multi-statement lines easily? Apart from this query, the Lynx seems to suit my requirements admirably, so I will wait for an answer from you before I go out and buy my Lynx.**

R Dram,
Saltash, Cornwall

THE LYNX is not provided with multi-statement lines. However, it does accept lines with decimal points, so 30.453 is a valid line number, which should allow you to insert as many lines as you like in a program. Multi-statement lines cannot be easily emulated on the Lynx. Having more than one statement to a line number is not considered very good programming practice in some circles, as it can lead to listings which are very hard to read and to debug. One time when they are very useful is when you want the computer to evaluate an If-Then statement, and to carry out, or jump, a series of instructions depending on the outcome of the evaluation. You can get round this, as I am sure you have learnt to do, on the ZX-81 by using the If-Then to jump a section of unwanted code. You may well find that other features provided by the Lynx will compensate for the lack of multi-statement lines.

I WANT ARRAYS

■ **Your review of the Computer Lynx stressed the potential of this machine for expansion and its CP/M compatibility. In another part of the magazine, it was mentioned that the Lynx was weak on string handling and could not use string arrays. The review mentions CP/M as handling files of data which presumably implies some form of array in use. Does this mean that the Lynx bas to expand to CP/M before file handling is possible or is the string restriction caused by the Basic used? If so, would Forth or Pascal provide arrays?**

T Asquith,
Newport, Shropshire.

YOU SEEM to have confused a coupie of points. The Lynx, when first issued, did not provide string arrays, but the reaction to this was so negative, the Basic was modified. String handling is a quite different issue from CP/M. CP/M stands for Control Program/Microcomputer, a very widely used disc-operating system developed and marketed by Digital Research, Pacific Grove, California. A large quantity of public domain software is available to run on CP/M machines.

DO NOT CHANGE

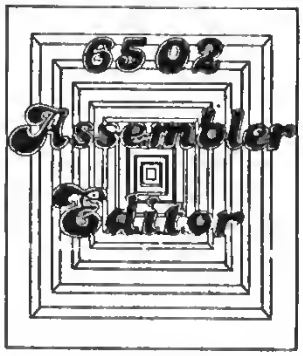
■ **I recently purchased by mail order the 'Book of Listings' for my BBC Model B Micro. I was somewhat disappointed to discover the book is written for the operating system 0.1 having recently had my micro fitted with the 1.2. Please could you advise which of the listings in the book will not run on the 1.2, and if possible, any changes to adapt those listings?**

Nigel Hunt,
Bagshot, Surrey

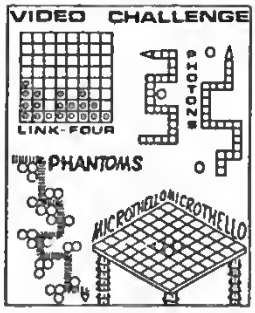
ALL PROGRAMS in the book will work on the 1.2 OS. ■

Q. E. D. Systems

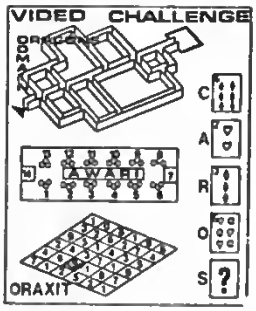
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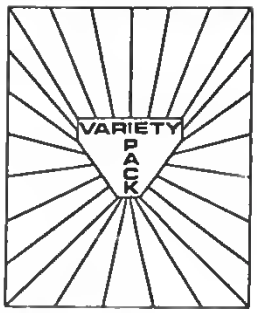
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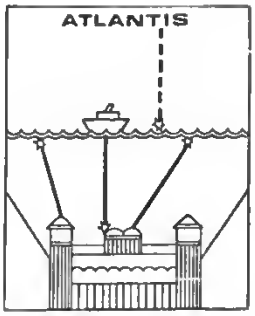
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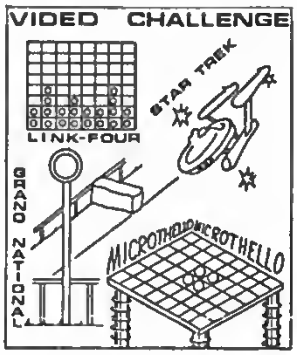
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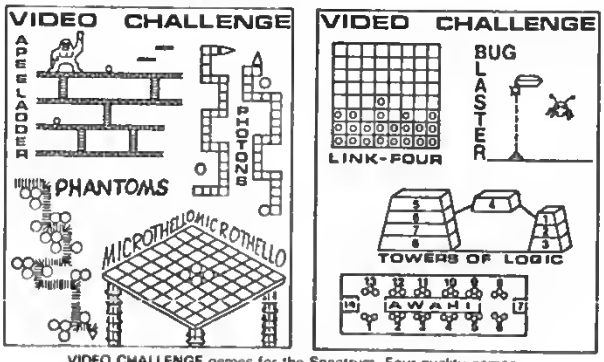
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Tubewars

J Bull,
Dursley,
Gloucestershire.

SPECTRUM

THE GAME TUBEWARS runs on either the 16K or 48K ZX Spectrum. The game is based on the arcade game Tempest. Although it is written entirely in Basic it is still fast enough to be enjoyable. Instructions are included in the listing but a couple of points should be stressed. When an electron finishes its run by reaching the rim of the tube a magenta cannon is drawn up, indicating that portion of the rim is electrified. If your cannon runs over this section it is destroyed. Your cannon is also destroyed if it is in the path of an enemy when it finishes its run; by reaching the tube rim. the level number is the number of enemy that have to reach the rim before the game ends. That is if your cannon is not destroyed before.

```
  S 10 TO 8000
  10 GO TO 5000
  30 PLOT 96,152  DRAW 36 12  DR
AW 36 -12  RETURN
  31 PLOT 168,152  DRAW 40 0  DR
AW 8 -24  RETURN
  32 PLOT 215 127  DRAW 12 -20
DRAW -12 -20  RETURN
  33 PLOT 168 63  DRAW 40 0  DRA
W 8 24  RETURN
  34 PLOT 96,63  DRAW 36 -12  DR
AW 36 12  RETURN
  35 PLOT 95,63  DRAW -40 0  DRA
W -8 24  RETURN
  36 PLOT 47 127  DRAW -12 -20
DRAW 12 -20  RETURN
  37 PLOT 95 152  DRAW -40 0  DR
AW -8 -24  RETURN
  40 LET x=16  LET y=8  LET dy=-
.5  LET dx=0  RETURN
  41 LET x=17  LET y=7  LET dy=-
.5  LET dx=1  RETURN
  42 LET x=19  LET y=8  LET dy=0
  LET dx=1  RETURN
  43 LET x=17  LET y=8.5  LET dy
=.5  LET dx=1  RETURN
  44 LET x=16  LET y=9.5  LET dy
=.5  LET dx=0  RETURN
  45 LET x=15  LET y=8.5  LET dy
=.5  LET dx=-1  RETURN
  46 LET x=13  LET y=8  LET dy=0
  LET dx=-1  RETURN
  47 LET x=15  LET y=7  LET dy=-
.5  LET dx=-1  RETURN
  60 OVER 0  INK 5  GO SUB 199+P
  BEEP .005 10  BEEP .005 20  IN
K 2  GO SUB 199+P  OVER 1
  80 IF c=P THEN LET sc=sc+100
PRINT AT y1,x1,a$(c1)  GO SUB 11
0
  90 IF d=P THEN LET sc=sc+75  P
RINT AT y2,x2,b$(c2)  GO SUB 130
  95 RETURN
 100 GO SUB 29+k  LET k=c  INK 3
  GO SUB 29+k  INK 2  IF p=c THE
N GO TO 7000
 110 LET c=INT (RND*8)+1  GO SUB
 39+c  LET x1=x  LET y1=y  LET d
x1=dx  LET dy1=dy  LET c1=1  RET
URN
 120 IF p=d THEN GO TO 7000
 130 LET d=INT (RND*8)+1  GO SUB
 39+d  LET x2=x  LET y2=y  LET d
x2=dx  LET dy2=dy  LET c2=1  RET
URN
 200 PLOT 95 152  DRAW 32,-32  P
LOT 168 152  DRAW -32,-32  RETUR
N
 201 PLOT 168 152  DRAW -32 -32
 PLOT 215 128  DRAW -64,-16  RET
URN
 202 PLOT 215 128  DRAW -64 -16
 PLOT 214 88  DRAW -64,16  RETUR
N
 203 PLOT 214,88  DRAW -64 16  P
LOT 167 64  DRAW -32,32  RETURN
 204 PLOT 167,64  DRAW -32 32  P
LOT 96 64  DRAW 32 32  RETURN
 205 PLOT 95 63  DRAW 32 32  PLO
T 49 88  DRAW 64,16  RETURN
 206 PLOT 49 88  DRAW 64,16  PLO
T 48 128  DRAW 64,-16  RETURN
 207 PLOT 48 128  DRAW 64,-16  P
LOT 95 152  DRAW 32,-32  RETURN
 209 RETURN
1010 GO SUB 29+p
1020 LET p=p+(INKEY$= "x" )-(INKE
Y$= "z" )  LET p=p+(p=0)*8-(p=9)*8
1030 INK 6  GO SUB 29+p  INK 2
1040 IF INKEY$= "" THEN GO SUB 6
0
1100 PRINT AT y1,x1,a$(c1)  LET
 y1=y1+dy1  LET x1=x1+dx1  LET c1
=c1+1  IF c1=9 THEN LET r=r+1  G
O SUB 100
1110 PRINT INK 4,AT y1,x1,a$(c1)
1120 PRINT AT y2,x2,b$(c2)  LET
 y2=y2+dy2  LET x2=x2+dx2  LET c2
=c2+1  IF c2=9 THEN LET r=r+1  G
O SUB 120
1130 PRINT INK 3,AT y2,x2,b$(c2)
1200 IF k=p THEN GO TO 7000
1210 IF r=t THEN PRINT AT 21 3;
 "All Enemy Have Reached Rim"  GO
 TO 7000
1500 GO TO 1000
5000 INK 2  BRIGHT 1  PAPER 0  C
LS  BORDER 0  CLS
5010 PRINT INK 6,AT 0,12;"TUBEWA
RS"  INK 4,AT 1,12;"  INK
```

```
 2 AT 15 9  (C) 1983 J.Bull"
5025 REM graphics D
5020 PRINT INK 4 AT 3 0,"D -Elec
trified Rim  100 Points  Elec
trified Rim When Reached  Do N
ot Touch Electrified Rim"
5025 REM graphics E
5030 PRINT INK 3,AT 7,0,"E -Over
 Rim  75 Points"
5040 PRINT INK 5 AT 9,0;"
 Rotate Clockwise"
5050 PRINT INK 4 AT 10 0;"Z
 Rotate Anticlockwise"
5060 PRINT INK 3 AT 11,0;"SPACE
 Fires Cannon"
5070 PRINT INK 6,AT 13,0;"LEVEL
 is Number of Enemy That  Have t
o Reach Rim Before End"
5080 PRINT INK 4 AT 16,0;"Select
 LEVEL  1  5  9"
5090 LET a$=INKEY$  IF CODE a$ 4
8 AND CODE a$ 53 THEN LET l=VAL
 a$ *10  GO TO 5110
5100 GO TO 5090
5110 CLS
5130 PRINT INK 6,AT 16,13;"TUBEW
ARS"  INK 4 AT 17,13;"
6000 OVER 0
6010 PLOT 96,152  DRAW 72 0  DRA
W 32 -8  DRAW 16 -16  DRAW 0 -41
  DRAW -16 -16  DRAW -32 -8
6020 DRAW -72 0  DRAW -32 8  DRA
W -16 16  DRAW 0,40  DRAW 16,16
  DRAW 32 8
6030 PLOT 128,119  DRAW 7,0  DRA
W 16 -8  DRAW 0 -7  DRAW -16 -8
  DRAW -7 0  DRAW -16,8  DRAW 0 7
  DRAW 16 8
6040 PLOT 96,151  DRAW 32,-32  D
RAW 72 0  DRAW 32,32
6050 PLOT 215 128  DRAW -64,-16
  DRAW 0,-8  DRAW 64,-16
6060 PLOT 96 64  DRAW 32 32  DRA
W 72 0  DRAW 32 -32
6070 PLOT 48,128  DRAW 64,-16  D
RAW 0 -8  DRAW -64 -16
6200 GO SUB 110  GO SUB 130
6205 OVER 1
6207 REM graphics A
6210 PRINT AT y1,x1," ",AT y2,x2
," "
6215 REM graphics A,B etc
6220 LET a$="AABBCCDD"  LET b$=
"AABB"+FGG
6230 LET p=1  GO SUB 30  LET k=9
6240 LET sc=0  LET r=0
6300 GO TO 1000
7000 CLS 0  FOR a=1 TO 5  FOR b
=6 TO 0 STEP -1  INK b  GO SUB 2
9+P  BEEP .01 b  NEXT b  BEEP .0
1 a  BEEP .01 a+2  BEEP .01 a+4
  NEXT a
7010 INK 5  PRINT AT 0 11;"Score
 ";sc;"  AT 1,14;sc
7020 PRINT AT 19 1;"Press  P  to
 Play  S  to Stop"
7030 IF INKEY$="p" OR INKEY$="P"
 THEN RUN 10
7040 IF INKEY$="s" OR INKEY$="S"
 THEN STOP
7050 GO TO 7030
8000 DATA 0,0,0,8,0,0,0,0
8010 DATA 0,0 8,20,8,0,0,0
8020 DATA 0,8,20,34,20,8,0,0
8030 DATA 8,20,34,65,34,20,8,0
8040 DATA 0,0,20,8,20,0,0,0
8050 DATA 0,34,20,8,20,34,0,0
8060 DATA 65,34,20,8,20,34,65,0
8100 FOR a=0 TO 55  READ b  POKE
 USR "a"+a,b  NEXT a
8120 RUN 10
```

Intelligent animal

C A Wilson,
Netherthang,
Huddersfield.

ZX-81

ARTIFICIAL INTELLIGENCE sounds fascinating, but is rarely claimed for the ZX-81. The most common form of AI, an animal-guessing game can be found in many books, written for most computers. However, studying a listing with a view to adapting it to the ZX-81 tends to leave one with the view that, without Data Read, it is simply impossible.

Not so. When "Uncle Clive" said "Who needs Data Read?" he offered a string-handling facility which, in some respects, is actually superior to the normal data-handling routines. Using string-handling allows a much simpler, neater listing. The only disadvantage is that the game would slow down if the number of animals became too great. Dimensioning A$ at 2000 provides sufficient space for reasonable use, but the number can be increased without risk if you wish to become wider-ranging.

How, then, does string-handling work? Simply, the string is a chain of empty boxes, of a length fixed in a Dim statement. Each box can be filled by one character of our choice. Any part of the chain can be called upon. If Q$=BACON, the Q$(4 TO)=ON. There are two snags to this. The first is the need to know exactly which part of the chain is required and the second is the time taken to look at each box separately.

Fortunately, the cure for the second problem is also the clue to the first problem. Before each entry in the string a pointer is placed, indicating the length of the entry. Thus, if the first entry is "an elephant", the string would be as in figure 1.

This can be used to skip quickly along the string. To read entry 2, you read Q$(1) — the length of entry 1 — add on the value found there, move the pointer along to this value on Q$, and the next box — called Next Free Byte — is where the length of entry 2 will be stored.

To use this in our program, we need three entries for every animal: first, an animal; then a distinguishing question; finally, a defining answer. In each case the length of entry must be stored in front of it.

Lines 99 to 170 initialise the variables. Line 172 sends the program to the shortened version necessary for the first round of play. This is placed at the end, since it will not be used again.

Figure 1.

	Chr$ 11	A	N		E	L	E	P	H	A	N	T	NFB
Q$	1	2	3	4	5	6	7	8	9	10	11	12	13

(continued on next page)

(continued from previous page)

The subroutine at 180 is used each time new information is written into the string. The subroutine at 500 similarly reads all information from Q$. Notice that they are placed near the beginning for speed. Lines 510 to 540 move the pointer along the string in jumps indicated by the Chr$ placed in NFB. When S=0, you have reached the entry you need. Line 550 then reads the number of characters indicated in NFB. The version of the game needed for all subsequent rounds starts at line 1000.

Finally, provision is made for saving all new information when you leave the game. Line 3500 prepares to Save. When you press Newline at 3525 it will begin the Save routine leading to an auto-start. It is a good idea to record on alternate sides of the tape, so that a mistake still leaves you the last playable version.

Once playing, do remember to answer in English. When you suggest a question, you must use a question mark. Similarly, when you name an animal, do not forget to put "a" or "an" in front of it. ZX-81 uses the information exactly as you give it, so you must be accurate. Check your spelling before you press Newline. A mistyped word is there for ever.

```
  99 REM INITIALISE
 100 DIM Q$(2000)
 110 LET L=2
 140 LET P=1
 150 LET Q$="AN ELEPHANT"
 160 LET NFB=1
 170 LET C=0
 172 GOTO 2000
 175 REM WAITE INTO Q$
 180 LET Q$(NFB)=CHR$ LEN A$
 190 LET Q$(NFB+1 TO NFB+LEN A$)
=A$
 195 LET NFB=NFB+1+LEN A$
 200 LET C=C+1
 205 LET N=C
 210 RETURN
 499 REM READ FROM Q$
 500 LET P=1
 505 LET B=C
 510 LET B=B-1
 520 IF B<=0 THEN GOTO 550
 530 LET P=P+1+CODE Q$(P)
 540 GOTO 510
 550 LET Z$=Q$(P+1 TO CODE Q$(P)
+P)
 560 RETURN
1000 PRINT "HAVE YOU THOUGHT OF
AN ANIMAL?"
1005 LET C=N-1
1010 INPUT A$
1020 IF CODE A$=52 THEN GOTO 104
0
1030 GOTO 1010
1040 IF C<1 THEN LET C=0
1044 GOSUB 500
1045 IF C=0 THEN GOTO 2117
1047 CLS
1050 PRINT ,,TAB 0,Z$,
1060 INPUT A$
1070 LET C=C+1
1080 GOSUB 500
1090 IF CODE A$=CODE Z$ THEN GOT
O 1120
1100 LET C=C-4
1110 GOTO 1040
1120 LET C=C-2
1130 GOSUB 500
1140 PRINT ,,TAB 0,"IS IT ";Z$;"
?"
1150 INPUT A$
1160 IF CODE A$<>52 THEN GOTO 12
00
1170 PRINT ,,TAB 0,"ARENT I CLE
VER?"
1175 FOR I=1 TO 30
1176 NEXT I
1180 GOTO 3000
1200 LET C=N
1210 GOTO 2170
2000 GOSUB 100
2005 CLS
2010 PRINT "HAVE YOU THOUGHT OF
AN ANIMAL?"
2090 INPUT A$
2100 IF CODE A$=52 THEN GOTO 211
5
2110 GOTO 2090
2115 GOSUB 500
2117 PRINT
2120 PRINT TAB 0,"IS IT ";Z$;"?"
2130 INPUT A$
2140 IF CODE A$<>52 THEN GOTO 21
70
2148 PRINT
2160 PRINT "AREN'T I CLEVER?"
2165 FOR H=1 TO 50
2166 NEXT N
2169 GOTO 3000
2170 PRINT
2180 PRINT "WHAT WAS IT?"
2190 INPUT A$
2195 LET Y$=A$
2200 PRINT ,,"WHAT QUESTION COUL
D I ASK TO  DISTINGUISH BETWEE
N ";A$;TAB 0;"AND ";Z$;"?"
2205 GOSUB 150
2210 INPUT A$
2215 GOSUB 180
2220 PRINT ,,"WHAT WOULD THE ANS
WER BE FOR ";TAB 0,Y$;"?"
2230 INPUT A$
2235 GOSUB 150
2240 GOTO 3000
3000 CLS
3010 PRINT AT 0,3,"MAY I TRY AGA
IN?"
3020 INPUT Z$
3029 CLS
3030 IF CODE Z$=52 THEN GOTO 100
0
3499 REM SAVE
3500 CLS
3510 PRINT AT 0,5,"PLEASE PREPAR
E THE TAPE TO SAVE MY NEW INFORM
ATION."
3520 PRINT ,,TAB 5,"PRESS NEWLIN
E WHEN YOU ARE READY"
3525 IF INKEY$="" THEN GOTO 3525
3530 SAVE "ANIMAL"
3535 CLS
3540 GOTO 1000
```

The machine-code loaders.

```
10 'LOADER 1
20 INPUT" ENTER START";S
30 LINE INPUT"DATA ";A$
40 PRINTA$
50 PRINT
60 POKES,VAL("&H"+LEFT$(A$,2)):A$=MID$(A$,4)
70 S=S+1:IF A$<>"" THEN 40 ELSE 30
10   LOADER 2
20 DATA 96,8C,ETC (MACHINE CODE DATA)
30 FOR F = START TO FINISH
40 READ A$:POKEF,VAL("&H"+A$)
50 NEXT
```

The machine code

```
START - 4000
 4000 - 96
 4001 - 8C
 4002 - 81
 4003 - 13
 4004 - 25
 4005 - 1
 4006 - 39
 4007 - C6
 4008 - 20
 4009 - 3D
 4010 - C3
 4011 - 4
 4012 - 0
 4013 - 1F
 4014 - 1
 4015 - 30
 4016 - 1F
 4017 - C6
 4018 - 20
 4019 - 96
 4020 - 8D
 4021 - 27
 4022 - 5
 4023 - 86
 4024 - AA
 4025 - A7
 4026 - 84
 4027 - 3A
 4028 - 86
 4029 - 9F
 4030 - A7
 4031 - 84
 4032 - 3A
 4033 - 8C
 4034 - 6
 4035 - 0
 4036 - 25
 4037 - F8
 4038 - 39
START = 4100
 4100 - C6
 4101 - 20
 4102 - 8E
 4103 - 4
 4104 - 21
 4105 - 34
 4106 - 10
 4107 - A6
 4108 - B4
 4109 - A7
 4110 - 1F
 4111 - 3A
 4112 - 8C
 4113 - 6
 4114 - 0
 4115 - 25
 4116 - F6
 4117 - 35
 4118 - 10
 4119 - 30
 4120 - 1
 4121 - 8C
 4122 - 4
 4123 - 40
 4124 - 25
 4125 - E6
 4126 - 8E
 4127 - 4
 4128 - 3F
 4129 - 86
 4130 - 80
 4131 - A7
 4132 - 84
 4133 - 3A
 4134 - 8C
 4135 - 6
 4136 - 0
 4137 - 25
 4138 - F8
 4139 - 39
START = 4200
 4200 - 8E
 4201 - 4
 4202 - 0
 4203 - C6
 4204 - 80
 4205 - A6
 4206 - 84
 4207 - 81
 4208 - AA
 4209 - 26
 4210 - 5
 4211 - E7
 4212 - 84
 4213 - A7
 4214 - 8B
 4215 - E0
 4216 - 30
 4217 - 1
 4218 - 1F
 4219 - 10
 4220 - C4
 4221 - 10
 4222 - 27
 4223 - 3
 4224 - 30
 4225 - 8B
 4226 - 10
 4227 - 8C
 4228 - 6
 4229 - 0
 4230 - 25
 4231 - E3
 4232 - 8E
 4233 - 4
 4234 - 20
 4235 - 86
 4236 - 80
 4237 - A7
 4238 - 80
 4239 - 8C
 4240 - 4
 4241 - 40
 4242 - 26
 4243 - F7
 4244 - 39
START = 4300
 4300 - 8E
 4301 - 6
 4302 - 0
 4303 - A6
 4304 - 84
 4305 - 81
 4306 - 2E
 4307 - 26
 4308 - 16
 4309 - C6
 4310 - 80
 4311 - E7
 4312 - 84
 4313 - E6
 4314 - 8B
```

(continued on page 155)

Scramble

Tony Eccles,
Leyland,
Lancashire.

DRAGON

THIS GAME USES only 1.5K and therefore can be greatly expanded. It uses both machine code and Basic. The object of the game is to see how long you can last without crashing or being blown up by a rocket. The rocket is

CHR$(170)

and the fuel is an inverse F. The keys used to play are the cursor keys, F and space-bar, The space-bar drops a bomb and F fires a missile. You get 20 points for hitting something with a bomb and 10 for hitting with a missile.

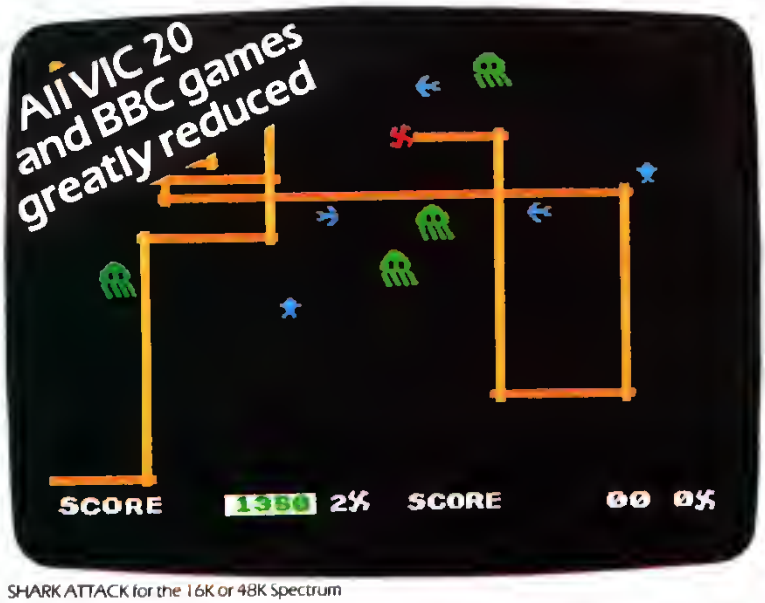
To load the program first type in the Basic — program 1 — that runs the game. Then Save this on tape. Next type in one of the two loader programs and begin typing in the machine code data, it is by the side of the mnemonics in the disassembly of my game, and check it. Finally check the machine code again then Save it on tape. There is a check in the Basic program to see if you have loaded the code — line 55 — if not then the program will stop. Also the reason for all the variables at the start is that this makes the program run quicker.

The machine code routines are as follows:

4000 draws the landscape
4100 scrolls the landscape to the left
4200 move up the missiles
4300 move the bombs down
4400 print the score
4500 sound of explosion
4600 sound of bomb
4700 sound of laser
4800 part of the sound routines

```
1 E0=4000:E1=4100:E2=4200:E3=4300:E4=4400:E5=4500:E6=4
600:E7=4700:T9=18
2 S0=0:S1=1:S2=2:S3=3:S4=4:S5=5:S6=6:S7=0.5:S8=10:S9=2
0
3 F1=341:F2=342:F3=343:F4=344:F5=345
4 L0=4024:L1=1060:L2=1024:Z1$=CHR$(128)+">=-":Z2$=STRI
NG$(5,128):H8=140
5 H0=100:H1=128:H2=141:H3=170:H4=179:H5=223:H6=251:H7=
480
6 T0=32:T1=96:T2=89:T3=90:T4=45:T5=46
10 M=0
20 POKE 65315,63
30 FORF=178 TO 181:POKEF,S0:NEXT
40 CLS S0:PRINT@S0,"score";:PRINT@S9,"ships"S3-M;
50 B=20:X=200
55 IF PEEK(4037)<>248 THEN PRINT:PRINT"PLEASE LOAD THE
 MACHINE CODE.":END
60 POKE H8,RND(S8)+S6:POKE H2,RND(S2)-S1:IF RND(S0)>S7
 THEN POKE L0,S6 ELSE POKE L0,H3
70 EXEC E0
80 EXEC E1
90 PRINT@X-S1,Z1$;
```

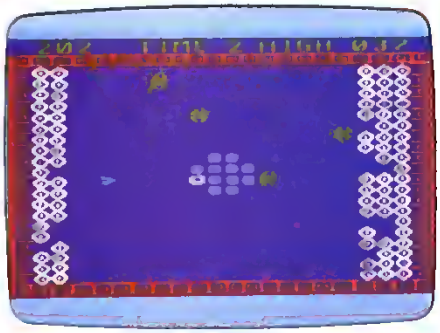
(continued on page 155)



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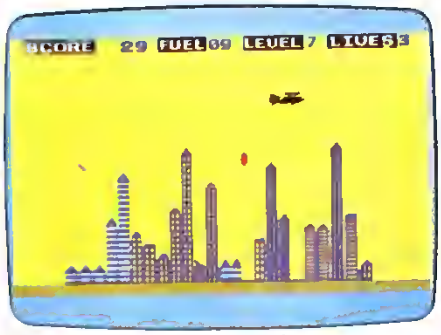
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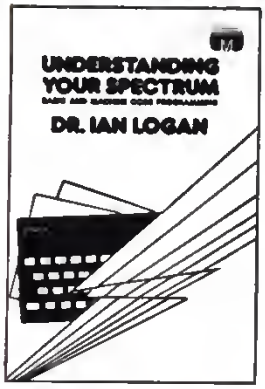




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MELBOURNE HOUSE

(continued from page 152)

```
4315 - 22
4316 - C1
4317 - 80
4318 - 27
4319 - 8
4320 - 96
4321 - B3
4322 - B8
4323 - 14
4324 - 97
4325 - B3
4326 - B6
4327 - B0
4328 - A7
4329 - B8
4330 - 22
4331 - 30
4332 - 1F
4333 - BC
4334 - 4
4335 - 0
4336 - 24
4337 - DD
4338 - 39

START = 4400
4400 - DC
4401 - B4
4402 - D3
4403 - B2
4404 - DD
4405 - B4
4406 - F
4407 - B3
4408 - BD
4409 - 95
4410 - 7A
4411 - 39

START = 4500
4500 - BE
4501 - 5
4502 - C0
4503 - A6
4504 - B4
4505 - 97
4506 - BC
4507 - F6
4508 - 1
4509 - 13
4510 - D7
4511 - BD
4512 - 56
4513 - D7
4514 - BE
4515 - BD
4516 - 12
4517 - C0
4518 - 30
4519 - 1
4520 - BC
4521 - 6
4522 - 0
4523 - 26
4524 - 1
4525 - 39
4526 - 7E
4527 - 11
4528 - 97

START = 4600
4600 - C6
4601 - D0
4602 - D7
4603 - BC
4604 - D7
4605 - BD
4606 - D7
4607 - BE
4608 - BD
4609 - 12
4610 - C0
4611 - 5C
4612 - 26
4613 - F4
4614 - 39

START = 4700
4700 - C6
4701 - 4
4702 - 96
4703 - BC
4704 - B8
4705 - 4F
4706 - 97
4707 - BC
4708 - BD
4709 - BA
4710 - D4
4711 - BD
4712 - BA
4713 - D6
4714 - 5A
4715 - 26
4716 - F1
4717 - 39
4718 - 5A
4719 - 26
4720 - ED
4721 - 39

START = 4800
4800 - BD
4801 - BA
4802 - D4
4803 - 96
4804 - BD
4805 - BD
4806 - BA
4807 - D6
4808 - BD
4809 - BA
4810 - D4
4811 - 96
4812 - BE
4813 - BD
4814 - BA
4815 - D6
4816 - 39
```

(continued from page 152)

```
100 R=X
110 IF PEEK(F1)=H5 AND X>T1 THEN X=X-TO:GOTO 160
120 IF PEEK(F4)=H5 AND 8>T9 THEN B=8-S1:X=X+S1:GOTO 16
0
130 IF PEEK(F3)=H5 AND 8<S9 THEN B=B+S1:X=X-S1:GOTO160
140 IF PEEK(F2)=H5 AND X<H7 THEN X=X+TO:GOTO 160
150 GOTO 170
160 PRINT@R-S2,Z2$;
170 IF PEEK(F5)=H5 THEN POKE X+L1,T5:EXEC E6
180 EXEC E3
190 IF PEEK(F4)=H6 THEN 290
200 EXEC E2
210 D=L2+X
220 F=S0
225 I=PEEK(D+F):IF I<H0 OR I>H1 THEN F=T2
226 F=F+S1:IF F<4 THEN 225
250 IF F>T2 THEN 350
260 IF PEEK(H4)=S0 THEN 60
270 PRINT@S5,"";:EXEC E4
280 GOTO 60
290 D=L2+X
300 F=S4
310 IF PEEK(F+D)<>H1 THEN POKEF+D,H1:POKE H4,S8:F=T3:A
M=AM+S8:GOTO 330
320 POKEF+D,T4:FORH=1 TO 10:NEXT:POKEF+D,H1
330 EXEC E3:EXEC E7:F=F+S1:IF F<=8 THEN 310
340 GOTO 200
350 PRINT@X,"xxxx";:FOR F=1 TO 10:EXEC E5:NEXT
360 M=M+S1:IF M>S3 THEN PRINT@TO,">GAME OVER<";:END
370 FORF=1 TO 1000:NEXT
380 GOTO 40
```

Mini synthesiser

Adam Barnes,
Huntingdon,
Cambridgeshire.

BBC

THIS PROGRAM is for a mini synthesiser using the BBC Model A or B. It will allow the user to key music directly from the keyboard, with four note variations and six different rhythm accompaniments. The pattern of the keys used to play music similar to the arrangement on a normal keyboard instrument, thus:

Black notes: S D G H J
White notes: Z X C V B N M ?

Two octaves may be accessed. Holding down the Shift key engages the top octave. Pressing one of the keys f0 to f3 changes the sound of the note played, thus:

f0: Ping-type tone.
f1: Ping-type tone with long echo.
f2: Fantasy-type vibrato sound.
f3: Vibrato with echo.

Chords — this being a main feature of the program — of two or three notes may be played. Auto-rhythm accompaniment is turned on or off with Tab and the rhythm required by one of the keys f4 to f9, thus:

f4: Rock rhythm version 1.
f5: Rock rhythm version 2.
f6: Rock rhythm version 3.
f7: Waltz.
f8: Fast swing.
f9: Slow march.

If auto-rhythm is on when a rhythm is selected that rhythm will commence at the beginning of the next bar. I would advise serious users of this program to fit a hardware modification so that the internal sound may be amplified — you will soon find the internal speaker inadequate. If, like me, you use a hi-fi amplifier then playing Acornsoft Planetoid once will convince you that the job was worth it.

```
  5 REM FOR £ READ HASH CHARACTER
 10REM ***SYNTHESISER***
 20REM A.BARNES 1983
 30*TV255
 40ENVELOPE1,0,0,0,0,0,0,0,120,-1,-1,-5,120,110
 50ENVELOPE2,0,0,0,0,0,0,0,126,-10,-1,-1,126,96
 60MODE7:RESTORE:PROCMC:PROCINS
 70R%=590:J%=0
 80FORA%=0TO12:READB%:A%?&C80=B%:NEXT
 90FORA%=0TO3:SOUND&10+A%,0,0,1:NEXT
100CALL&C00:Z%=INKEY(-1)*-48:IF?&70<255SOUND&11,1,?&70*4+48+Z%,1
110IF?&71<255SOUND&12,1,?&71*4+48+Z%,1
120IF?&72<255SOUND&13,1,?&72*4+48+Z%,1
130IFADVAL(-5)>OREADA%,B%,C%:SOUND0,-J%*A%,B%,C%:IFC%=ORESTORER%
140IFINKEY(-97)J%=NOT(J%):RESTORER%:FOR1%=0TO999:NEXT
150IFINKEY(-21)R%=590
160IFINKEY(-117)R%=650
170IFINKEY(-118)R%=710
180IFINKEY(-23)R%=760
190IFINKEY(-119)R%=820
200IFINKEY(-120)R%=860
210IFINKEY(-33)ENVELOPE1,0,0,0,0,0,0,0,120,-1,-1,-5,120,110
220IFINKEY(-114)ENVELOPE1,2,0,0,0,0,0,0,120,-1,-1,-1,120,110
230IFINKEY(-115)ENVELOPE1,1,2,-2,1,2,4,4,120,-1,-1,-2,120,110
240IFINKEY(-116)ENVELOPE1,2,1,-1,1,2,4,2,120,-1,-1,-5,120,110
250GOTO100
260DEFPROCMC
270FORO%=0TO2STEP2:P%=&C00
280[OPT O%
290LDA£0:STA&74:STA&75:LDA£255:STA&70:STA&71:STA&72
300.B LDX&75:LDA&C80,X:TAX:LDY£255:LDA£&81
310JSR&FFF4:CPX£0:BEQ A:LDX&74
320LDA&75:STA&70,X:INX:STX&74
330CPX£3:BNE A:RTS
340.A INC&75:LDA&75:CMP£13:BNE B:RTS:]:NEXT
350ENDPROC
360DEFPROCINS
370PRINTCHR$141;"SYNTHESISER"
380PRINTCHR$141;"SYNTHESISER"
390PRINTCHR$130;"Keyboard Layout:"
400PRINTCHR$131;"_____"
410PRINT"Black notes:      S D   G H J"
420PRINT"White notes:    Z X C V B N M ,"
430PRINTCHR$130;"Function Keys:"
440PRINTCHR$131;"                    "
```

(continued on page 159)



MTX500 £275 MTX512 £315

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Memotech praducts are designed and made in Oxfard and Witney



The All-Purpose System

The MTX Series

The MTX Series is o new deporture in micro-computer technology. Whether your needs os o user ore for personol progromming, gomes ploying, scientific or process control, educotionol or business use the MTX Series is olreody copoble or very easily odoptoble to olmost every opplicotion. Glonce through the stondord feotures below — you'll see whot we meon.

Software

The MTX's 16k ROM contoins severol longuoges ond routines which enoble the novice or the experienced progrommer to moke full use of the mochine. Stondord longuoges ore MTX BASIC, LOGO type commonds, ond NODDY. ROM routines include on ASSEMBLER/ DISASSEMBLER with screen disploy of the Z80 CPU registers, memory ond progrom, which con be monipuloted from the keyboord. Mochine code progroms con be stepped through one instruction ot o time, ond eosily colled from within BASIC progroms. A further feature is the Virtuol Screen focility which enobles the progrommer to define sections of the screen to work independently whilst maintoining oll full screen focilities. Poscol is ovoiloble os on odd-on ROM pock.

Hardware

The MTXS00 hos 32k of user RAM os stondord (64k on the S12), expondoble to S12k plus 16k of dedicoted video RAM. Sixteen colours, 40 column text, 2S6 x 192 high resolution grophics with oll sixteen colours ovoiloble, ond easily moveable user defined grophics (Sprites) combine to moke effective screen disploys quick ond simple to ochieve. Stondord outputs ore centronics printer port, two joystick ports, on uncommitted I/O port, 2400 Boud Cossette port, seporote TV ond Video Monitor ports, 3 voice sound with hifi output plus o dedicoted gomes cortridge port Other stondord features include the Z80A processor running ot 4MHz, reol time clock, full moving key keyboord with 79 keys including eight function keys ond seporote numeric pod.



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The MTX series hos been produced with performonce ond expondobility uppermost in the design teom's thoughts. When exponded to Disc level the computer supports the following focilities, which will be ovoiloble in October:

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- *S¼" floppy discs*
- *S¼" hord discs*
- *CP/M 2 2, enobling the widely ovoiloble ronge of CP/M bosed software*
- *Memotech Silicon discs — multiples of 2S6K of fost RAM expondoble to Bm bytes*
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- *A/D ond D/A converters*
- *Networking*

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Software for the MTX SERIES

CONTINENTAL SOFTWARE UNIT 24 STATION LANE WITNEY

(continued from page 155)

```
450PRINT"f0:'Ping'type tone from keys."
460PRINT"f1:'Ping'type tone with long echo."
470PRINT"f2:Fantasy/feet vibrato sound."
480PRINT"f3:Medium vibrato-echo."
490PRINT"f4:Rock rhythm 1."
500PRINT"f5:Rock rhythm 2."
510PRINT"f6:Rock rhythm 3."
520PRINT"f7:Waltz."
530PRINT"f8:Feet swing."
540PRINT"f9:Slow march."
550PRINT"   TAB:Auto rhythm on/off."
560PRINT"SHIFT:Hold down to engage top octave."
570PRINT"CHR$(136)"*** PLAY NOW ***":ENDPROC
580DATA-98,-82,-67,-51,-83,-100,-84,-101,-85,-86,-70,-102,-103
590DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
600DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,1,0,0,1,2,4,1,0,0,1,2,4,1,0,0,1
610DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
620DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
630DATA2,6,1,0,0,1,2,6,1,0,0,1,2,6,1,0,0,1,2,6,1,0,0,1
640DATA0,0,0
650DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
660DATA2,6,1,0,0,1,2,4,1,0,0,1,2,6,2,0,0,2,2,4,3,0,0,1,2,6,2,0,0,2
670DATA2,6,2,0,0,2,2,6,2,0,0,2,2,4,2,0,0,2,2,6,2,0,0,2
680DATA2,5,1,0,0,3,2,5,1,0,0,1,2,5,1,0,0,1
690DATA2,6,1,0,0,3,2,6,1,0,0,1,2,6,1,0,0,1
700DATA0,0,0
710DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
720DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
730DATA2,6,3,0,0,1,2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,4,1,0,0,1
740DATA2,5,3,0,0,5,2,5,3,0,0,3,2,6,1,0,0,1
750DATA0,0,0
760DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
770DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
780DATA2,6,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
790DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
800DATA2,5,1,0,0,1,2,5,1,0,0,1,2,5,1,0,0,1
810DATA0,0,0
820DATA2,6,2,0,0,2,2,4,2,0,0,2,2,6,1,0,0,1,2,6,1,0,0,1
830DATA2,4,2,0,0,2,2,6,1,0,0,1,2,6,1,0,0,1
840DATA2,4,2,0,0,2,2,5,2,0,0,2,2,5,2,0,0,2
850DATA0,0,0
860DATA2,4,B,0,0,4,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
870DATA2,6,4,0,0,4,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2,2,4,2,0,0,2
880DATA2,5,3,0,0,5,2,6,3,0,0,5
890DATA0,0,0
```

Tron II

H Singh,
Birmingham.

VIC-20

THIS IS A TWO-PLAYER game of skill based on the light-cycle game in the film Tron. It runs on the unexpanded Vic-20 and uses the Vic's sound and high-resolution graphics facilities to the full. The two players play the roles of Tron and the MCP and the objective of the game is to move along the grid trying to trap the opponent while avoiding the walls and trails. The first player to win 10 rounds wins the game.

Tron, who leaves the blue trail, uses the Commodore and Shift keys. The MCP, who leaves the red trail, uses the cursor keys. The keys move you anti-clockwise or clockwise hy 90°.

The program has two parts; the initialisation program which sets up the graphics and the main program which plays the game. Type in both programs and Save them before running. The structure of the main program is as follows:

10	Changes screen colour end sets up the variables
15 to 45	Set up graphic screen
70 to 95	Tron keyboard entry and check for crash
100 to 125	MCP keyboard entry and check for crash
500 to 630	Movemant routines
1000 to 2010	Cresh routines
2340 to 2900	Print winner and ask for replay

Death worm

K R Littlefield,
Carshalton,
Surrey.

ZX-81

DEATH WORM IS A variation on the arcade game Centipede. Most of the action is performed by machine-code routines thus making the game fast.

There are four main machine-code routines — move worm, move hase and fire, move bomhs and the master program.

First, you must reserve some space for the code. Do this by entering:

1 REM (95 x's)
2 REM (98 x's)
3 REM (74 x's)
4 REM (24 x's)

then enter the code loader — listing 1. Run

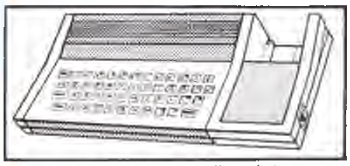
(continued on page 167)

```
25 REM*INITIALISATION*
30 REM****************
35 PRINTCHR$(142)CHR$(8)
40 POKE52,28 POKE56,28 FOR1=28TO57 FORJ=0TO7 READN POKE7168+8*I+J,N NEXT NEXT
45 END
50 DATA198,230,246,222,206,198,198,198
55 DATA126,126,16,16,24,24,24,24,248,200,200,248,240,216,216,216
60 DATA252,252,204,204,204,204,252,252,0,0,0,0,0,0,0,0
65 DATA0,24,24,0,0,24,24,0,198,238,254,214,198,198,198,198
70 DATA254,254,198,192,192,198,254,254,252,252,204,204,252,192,192,192
75 DATA12,12,12,255,255,12,12,24,36,66,90,219,219,66,126
80 DATA126,66,90,90,219,195,36,24,12,252,130,185,185,130,252,12
85 DATA12,63,65,157,157,65,63,12,4,4,168,168,169,169,40,40
90 DATA40,40,42,42,106,106,4,4,4,4,42,42,106,106 40,40
95 DATA40,40,168,168,169,169,4,4,4,4,170,170,170,170 4 4,40,40,40,40,105,105,40
40
100 DATA126,126,102,102,102,102,126,126,56,56,24,24,24,24,60,60
105 DATA126,126,6,126,126,96,126,126,126,126,6,126,126,6,126,126
110 DATA96,96,108,108,126,126,12,12,126,126,96,126,126,6,126,126
115 DATA126,126,96,126,126,102,126,126,126,126,102,12,24,48,48,48
120 DATA126,126,102,126,126,102,126,126,126,126,102,126,126,6,126,126
```

```
 1 REM*    TRON II    *
 3 REM*  MAIN PROGRAM *
 4 REM*****************
 5 POKE36878,10 POKE36869,255 CLR PRINTCHR$(147)CHR$(8)
 10 POKE36879,24 POKE36865,200 CO=30720 M=7904 T=7970 T1=1 M1=1 PRINT"J"
 15 FOR1=7724TO8163 POKE1,37 POKE1+CO,0 NEXT
 20 POKE7702,44 POKE7702+CO,12 POKE7723,42 POKE7723+CO,12 POKE8164,43 POKE8164+C
O,12
 25 POKE8185,45 POKE8185+CO,12
 30 FOR1=7703TO7722 POKE1,46 POKE1+CO,12 POKE1+462,46 POKE1+462+CO,12 NEXT
 35 FOR1=7724TO8142STEP22 POKE1,47 POKE1+CO,12 POKE1+21,47 POKE1+21+CO,12 NEXT
 40 POKEM-1,46 POKEM-1+CO,10 POKEM,40 POKEM+CO,0 POKET-1,46
 43 POKET-1+CO,14 POKET,40 POKET+CO,0
 45 POKE198,0 PRINT"[illegible]"+CHR$(34)+"##!"
 50 POKE36865,38 PRINT"[illegible]"TAB(7)TSTAB(17)MS
 70 POKE36876,225 A=PEEK(653)
 80 IFA=2TNENT2=-22*(T1=-1)+1*(T1=-22)+22*(T1=1)-1*(T1=22) GOTO90
 85 IFA=1TNENT2=-22*(T1=1)-1*(T1=-22)+22*(T1=-1)+1*(T1=22) GOTO90
 88 T2=T1
 90 IFPEEK(T+T2)<>37THEN1000
 95 GOSUB500 POKE36876,0 T1=T2
 100 B=PEEK(197)
 105 IF8=31TNENM2=-22*(M1=-1)+1*(M1=-22)+22*(M1=1)-1*(M1=22) GOTO118
 115 IFB=23THENM2=-22*(M1=1)-1*(M1=-22)+22*(M1=-1)+1*(M1=22) GOTO118
 116 M2=M1
 118 IFPEEK(M+M2)<>37THEN2000
 125 GOSUB600 M1=M2 GOTO70
 500 RESTORE
 505 READA,B,P,CH
 510 IFT1=AANDT2=BTHENPOKET,P POKET+CO,t4 T=T+B POKET,CN POKET+CO,0 RETURN
 520 GOTO505
 530 DATA1,1,46,40,-1,-1,46,41,22,22,47,39,-22,-22,47,38
 535 DATA1,-22,45,38,1,22,42,39,-1,-22,43,38,-t,22,44,39
 540 DATA22,-t,45,41,22,1,43,40,-22,-1,42,41,-22,1,44,40
 600 RESTORE
 618 READA,B,P,CN
 620 IFM1=AANDM2=BTHENPOKEM,P POKEM+CO,10 M=M+B POKEM,CH POKEM+CO,0 RETURN
 630 GOTO610
 1000 POKET+CO,2 POKE36874,200 FORI=1TO4000 NEXT POKE36874,0 POKE36876,0 MS=MS+1
 IFMS=10TNEN2500
 1010 GOTO10
 2000 POKEM+CO,2 POKE36874,200 FOR1=1TO4000 HEXT POKE36874,0 TS=TS+1 IFTS=10TNEN
2500
 2010 GOTO10
 2340 IFMS>TSTNENPRINT"[illegible]THE[illegible] "CHR$(34)"##"
 2350 IFTS>MSTNENPRINT"[illegible]"
 2360 GOTO2800
 2500 PRINT"[illegible]        [illegible] 11"
 2510 PRINT"        [illegible]"
 2525 PRINT"[illegible]  THE WINNER OF TNE"
 2530 PRINT"[illegible]  GAME 1S ",
 2540 IFMS>TSTNEHPRINT"TNE [illegible]"CHR$(34)"##"
 2560 IFTS>MSTNENPRIHT"[illegible]"
 2800 PRINT"[illegible]  ANOTHER GAME (Y/N)"
 2810 GETA$ IFA$="Y"TNENRUN
 2020 IFA$<>"N"TNEN2810
 2900 SYS64802
```

HOME COMPUTERS

20K AQUARIUS



AQUARIUS: The brand new Aquarius Personal Computer is part of Mattel Electronics latest developments in advanced technology and offers full home computing facilities, as well as extensive game play, using a very wide renge of plug in cartridges. Since Aquarius is e Mattel Electronics product, it benefits by the company's wide experience of producing high technology equipment, as well as their game programming expertise which is evident from the advenced games which have been produced for the Intellivision. Aquarius costs £99 and comes with microsoft basic built in. It is so simple to use that you'll be writing your first programs within minutes of taking the machine out of its box. You can even record the programs on your own cassette recorder at home, so you can use them again at e later date. Most available domestic tape recorders are competible with the Aquarius.

A POWERFUL MACHINE: For all it's simplicity, it is also very sophisticated. It has e Z80A orocessor end it comes with 8K of built in ROM end 20K of RAM, expendable to 52K. It has e display of 40x24 characters, and a graphic resolution of 320x192 with e totel character set of 256 (including the complete ASCII set with upper end lower case letters, numbers and additional graphic symbols). The keyboard has 49 full stroke moving keys, unlike some of the cheaper machines which have membrene keyboards. The size of the machine (excluding any of the additional peripherals), is 13"x6"x2".

PERIPHERALS: It is very easy to increase the capabilities of your Aquarius as all the peripherals plug straight into one another. You can edd e Printer, a Modem, e Oate Recorder, Mini Expender end other items. All of the peripherels are very easy to install end what is more, they're easy to use. But the best news of all is, they're easy to efford.

CPM OPERATING CAPABILITY: The Aquarius is capable of being expanded to 52K RAM end later in 1983 e disk drive will be available for it, with the commercial CPM business operating system. This will allow you access to one of the largest software libraries in the world, with literelly hundreds of programs available for you to use.

CARTRIGES: Various sophisticated programs will be launched on plug in cartridges such as e Visicalc type spreadsheet and e word processor. In addition there will be dozens of games and utilities and eiternetive languages such as Logo, which combined with the built in microsoft basic gives an unbeetable combination of high quality progremming ebility.

20K MATTEL AQUARIUS – £86 + VAT = £99

£99

ATARI 400/800



NEW LOW PRICES

ATARI 400/800: With the Atari Personal Computers, you can play the ultimate in T.V. games, teach yourself new subjects or skills, belence budgets, and even write your own computer programs in Basic.

SPECIFICATIONS: Both the Atari 400 and 800 can display in up to 18 colours, each with 16 intensities. They have four independent sound synthesizers for music tunes/game sounds, giving four octaves with veriable volume end tone control on your T.V.'s speaker. The display graphics are of amazing quality, having a detailed resolution of 320 x 192, comprising 24 lines of 40 characters. Ateri personal computers have e standard 10K ROM operating system. In addition the standard Ateri 400 (£129) comes with 18K of RAM end the expended version with 48K (£178). The Atari 800 (£279) comes with 48K as standard. Both the 400 and 800 are now supplied with a FREE £40 Basic Programming Kit, which includes the Basic Programming Cartridge, as well as a 120 page Basic Reference Manuel end the 184 page Self Teaching Manual by Bill Carris celled 'Inside Ateri Basic', so you can begin programming streight away, without buying eny 'extras'. Even e melns plug is supplied!

OVER 500 PROGRAMS AVAILABLE: The Ateri computers are supported by well over 500 programs available for your use, e larger selection then you will find on any other television game or home computer! The wide selection puts Atari way eheed of the competition. Just fill in the coupon end we will be pleased to send you e full price list which gives deteils of our renge of software available for entertainment, home education, programming end home office use. We think you'll agree when we say it's quite impressive.

100 FREE PROGRAMS FROM SILICA SHOP: If you buy your Ateri Home Computer from Silica Shop, you will recieve e FREE presentation pack of 6 cassettes, conteining 100 programs including games, utilities and demonstrations. A 16 page booklet giving full deteils of all of these programs is available on request. If you have elreedy purchased your computer elsewhere you can buy the set of 6 cassettes for £30. Whet's more, Silica Shop offer a two year guarentee on all computers as well as e FREE joystick. This edds up to e great offer thet we believe can't be beeten or metched by eny of our competitors.

ATARI 400 WITH 16K £129
ATARI 400 WITH 48K £178
ATARI 800 WITH 48K £279

£129

VIDEO GAMES

COLECOVISION



THE SYSTEM. The CBS Colecovision offers new stenderds in video game pley. The excellent graphics ere well implemented with arcade titles such es Zaxxon, Lady Bug, Gorf, Wizard of Wor, Carnival, Mouse Trap and the lovable Smurfs. The console comes supplied with a three screen arcade quality version of DONKEY KONG. Parker and other companies have also announced rangas of cartridges for Colecovision, to further enhence the wide renge of quality titles available for this new television games machine.

THE CONSOLE: The CBS Colecovision video games system has advanced technology which produces superlative graphics resolution end excellent sound effects. The styling of the console and hand controllers has been carefully researched, the console is designed to complement modern hi-tech equipment, and has clear features for easy operation. The hand controllers allow fingertip control via the 8 direction joystick, and feature 2 independent fire buttons. The push button keyboard is used for game selection and for game control with some cartridges. The hand controllers ere detachable and are connected to six feet of telephone coil cable, storing neatly away in the console when not in use.

ATARI EXPANSION MODULE. The Atari converter module allows Ateri VCS software cartridges to be played on the Colecovision console, allowing owners the freedom to purchase from the extensive renge of Ateri competible cartridges. It also means thet existing Atari owners can buy the CBS Colecovision games system without discarding their software library. Silica Shop offer part exchenge facilities if you wish to upgrede.

TURBO EXPANSION MODULE: The Turbo Driver Expension Module allows you to actually drive tl a vehicle that appears on your T.V. screen. The module consists of a steering wheel, dashboard end acceleretor pedel. One hend controller is mounted on the dashboard to provide e gear chenge unit. The module comes complete with e Turbo Driver cartridge, the first of several cartridges to make use of the module, which provides all the action of sitting in the driving seat. This facility is unique to CBS Colecovision.

HOME COMPUTER EXPANSION MODULE. The Home Computer Module scheduled for late 1983, allows conversion of the games unit into e sophisticated Home Computer. This flexibility of design is an important feature of the CBS Colecovision System.

COLECOVISION - £127.82 + VAT = £147

£147

VECTREX



THE SYSTEM: Vectrex is e totally unique Home Arcade System, which has been exclusively designed end engineered to duplicate real arcade game play. Complete with its own monitor display, Vectrex won't ceuse eny erguments over the use of the family's television because it has its own built in screen.

THE SCREEN: Vectrex does not use ordinery display techniques, instead it uses vector scanning to control the images on the screen. With this scanning method, the gun only updates the area of the screen that has changed, whereas e normal T.V. re-transmits the ENTIRE screen 50 times e minute. It is this thet gives Vectrex its speed, and means that very little computer power is required for screen control, end the results provide very fast responding and clear images. These 'Vector Graphics' ere used in several arcade games such as Asteroids end Battlezone, to give you incredibly high resolution and quality. Vectrex brings all of this from the arcade right into your living room. The Vectrex screen is capeble of displeying 80 columns by 40 lines, which is significent to the extensive developments plenned for the system.

EXCITING SOUNDS AND ELECTRONICS: Vectrex has an advenced microprocessor with more speed and power and exciting effects then meny home video games systems.

REAL ARCADE CONTROLS: Vectrex hes a unique control panel, similer to those used in many real arcade games, with 4 concave action buttons and a full 360° self centering joystick. This control penel has e 4 foot detachable cord for maximum pleyer freedom.

REAL ARCADE GRAPHICS. Vectrex has its own 9 inch verticel screen end unlike a conventional T.V. screen, uses advenced display technology to achieve brilliant, high resolution imagery end superb game play never before possible. The Vectrex display provides special effects too, such as 3 D rotation and zooming in end out, which e regular T.V. cennot match. Using a black end white monitor, each Vectrex game comes supplied with its own coloured plestic screen overlay to edd to the excitement of game play. The ranga of Vectrex certridges (£19.95 each), gives a good selection of arcade games such as Berzerk, Scramble, Rip-Off end Bomber Attack. Vectrex comes complete with e fast paced 'Minestorm' game built into memory.

VECTREX. Vectrex has an advanced state-of-the-ert microprocessor with more speed than other T.V. games.

VECTREX – £112.17 + VAT = £129.00

£129

WHO ARE SILICA SHOP?

Silica Shop are one of the leading specialist suppliers of Video Games & Personal Computers. We consider that our service to those who already own or to those who are interested in any products in our renge cannot be matched by any other supplier. Just look at what we have to offer:

* **SHOP DEMONSTRATION FACILITIES:** we provide full demonstration facilities at our shop in Sidcup so that you can get hands on experience of our renge.
* **SHOP OPENING HOURS:** we are open from Monday to Saturday 9 am - 6.30 pm, but close at 1 pm on Thursday's and 8pm on Friday's.
* **MAIL ORDER:** we are a specialist mail order company and are able to supply goods direct to your door at no extra cost.
* **FREE FIRST CLASS DELIVERY:** all orders are sent Post and Pack ing FREE, most all items being despatched by FIRST CLASS POST within 24 hours of us receiving your order. If you require overnight delivery this can be arranged at a charge of £3 for items under £50, or alternatively £5 for items over £50.
* **MONEY BACK UNDERTAKING:** If you are totally dissatisfied with your purchase you may return it to us in good condition within 15 days for a full refund.
* **PART EXCHANGE:** we are willing you will to edd the full of our current selling price in part exchange on your old Mattel Intellivision or Atari console (and related components). If you decide to buy a new video game or personal computer from us.
* **SECONDHAND GOODS:** we sell secondhand Mattel & Atari consoles/cartridges (with a full 1 year guarantee) at less than half of our normal retail prices.
* **COMPETITIVE PRICES:** both our prices and service are very competitive. We are never knowingly undersold and will normally match any genuine like for like price quoted by our competitors (e.g. should we find you actually have the goods in stock). We will also send the order to you post and packing free!
* **HELPFUL ADVICE:** our staff are all sales staff and are always ever able to give you advice on the suitability of various computers for T.V. games.
* **SERVICE/REPAIRS:** we are also able to arrange repairs to our range, often whilst you wait. A repair service facility. We will support you, maintain long after you buy it.
* **ATARI SERVICE CENTRE:** we are now an authorised Atari service centre and can therefore accept repairs on all Atari equipment (TV Games and Computers) even if you did not originally purchase it from Silica Shop. All repairs during the manufacturers 1st year warranty period are fully completed FREE OF CHARGE.
* **2 YEAR GUARANTEE:** we offer a 2 year extension on some manufacturers 12 month guarantee, including Atari Personal Computers.
* **VIDEO GAMES AND COMPUTER CLUBS:** we offer a full information service on all video games and computers in our range. Advanced information on many new developments is often available as you are always kept informed. We have issue regular newsletters on software releases so make sure that you join our club.
* **OVERSEAS ORDERS:** we regularly send goods overseas and use various despatch services. Please tell us where you require and we will gladly give a quotation.
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VIDEO GAMES



ATARI

ATARI VCS (2600) — THE NO 1 BRAND LEADER IN THE U.K.

ATARI: The Atari Video Computer System known as the Atari VCS or the 2600 has now become the T.V. game brand leader. In the U.K. there are over 700,000 owners of the VCS with access to a range of over 200 different plug in cartridges, each having a multitude of different variations and difficulty levels. Every system comes complete with the main console, two individual joystick controllers, a pair of paddle controllers, aerial splitter, mains adaptor, a 27 game Combat cartridge and a FREE 112 game SPACE INVADERS cartridge. The console also incorporates special circuits designed to protect your T.V. set.

SECONDHAND GAMES: We currently have several secondhand Atari VCS units in stock which we are selling for only £39 (inc VAT). This price includes the Console, with Combat Cartridge and all the accessories, as well as a 12 month guarantee. We also have stocks of several secondhand cartridges many at half price (all with 12 month guarantee). We will normally buy back secondhand units and cartridges at ¼ of our normal selling price.

£39

EXTENSIVE CARTRIDGE RANGE: The Atari VCS is so popular that in addition to Atari's own cartridges, there are over 150 compatible cartridges, produced by at least a dozen different third party manufacturers. Silica Shop has one of the largest cartridge selections available in the U.K. Our range of over 200 titles (printed either side of this column), includes items in stock now, as well as many of the new releases for later in 1983.

SILICA ATARI CLUB: Silica Shop has over 20,000 Atari VCS club members registered on our computer. As a specialist company we are able to obtain advance information about new developments and send detailed catalogues to all of our club members, enabling them to evaluate new products before they buy. This is a totally FREE service, to receive your copies complete the coupon below.

SERVICE CENTRE: Atari International (UK) Inc has recently appointed Silica Shop as an authorised Atari Service Centre. This means that we can now service your Atari VCS or 400/800 (under guarantee if applicable), whether or not you purchased it from us.

VCS COMPUTER KEYBOARD: A keyboard will soon be launched to convert the VCS into a fully programmable home computer. For further details, join our club by completing the coupon below. We will then let you know when further information is available.

STARPATH SUPERCHARGER: The supercharger plugs into the cartridge socket of your VCS and expands its RAM almost 50 fold, from 128 to 6,272 bytes. This increased memory adds vivid high resolution graphics capabilities and significantly lengthens the game playing time. Supercharger has a range of multi-load games (at £19.45 each), these offer the facility to play a game in several distinct parts (great for adventures), the next section being loaded when you have completed the previous one, thus enhancing the game play. For further information please complete the coupon below.

£69

ATARI VCS CONSOLE — With SPACE INVADERS + COMBAT £60 + VAT = £69

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Mains Adaptor
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Spider Fighter
Stampede
Starmaster
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APOLLO
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Racquetball
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Skeet Shoot
Space Cavern
Space Chase

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Kaboom
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Maze Craze
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Surround
Swordquest E
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Quest for Gold
Tally Ho
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ACCESSORIES

We stock a wide range of accessories for the Atari VCS and 400/800 personal computers. The same accessories can be used on the Commodore VIC range of computers. The Wico range can also be used with the Texas Instruments computers on purchasing a special adaptor. To give you an idea of the range available, just take a look at the following list:



Trackball by Wico

LE STICK: A mercury filled joystick specially made for one handed operation, with thumb fire button.

QUICK - SHOT: This joystick features a contoured handle grip, thumb trigger and optional base fire button. It is supplied with 4 sure foot suction grips.

STARFIGHTER: Neat and compact with a small direction stick. Metal interior for added strength.

VIDEO COMMAND: With a tapered handle, this joystick is for one handed use. It has a directional control which is similar to a jet fighter joystick.

WICO RED-BALL: An arcade type joystick with a red ball handle, it features 2 fire button locations, one at the base and one on the stick. It comes supplied with 4 grip pads for easier table top use.

WICO STRAIGHT - STICK: The main feature of this joystick is it's arcade style, bat handle grip. It also has 2 fire buttons. Four grip pads included for table top use.

WICO TRACKBALL: A true arcade style trackball for use with your Atari or Commodore VIC. This product is designed to give arcade control in your living room.

12' EXTENSION LEAD: A 12' extension for Atari and Atari compatible joysticks for greater player freedom.



Wico Straight Stick with Stick Fire Button

MATTEL INTELLIVISION



MATTEL INTELLIVISION The Mattel games unit is a most versatile T.V. game which offers 3-D graphics quality for only £98. Each cartridge comes with 2 overlays which fit over the unique hand controller giving easy directions for game play. Using the handset's control disc, objects can be moved accurately in 16 directions giving a realistic simulation of lifelike movement. From 1st September 1983, the Mattel Intellivision T.V. Games Console will come with a **FREE VOICE SYNTHESIS MODULE**, normally priced at £50. This unit creates high quality synthesised male and female voices as part of the game play on certain cartridges.

NEW MATTEL CARTRIDGE RELEASES Why not complete the coupon below and join the Silica Mattel Owners Club and receive our **FREE** news bulletins and 16 page catalogues detailing new Mattel releases. There will soon be over ninety cartridges available for the Mattel, and a small selection from these is listed below:

MATTEL: Arctic Squares, Burger Time, Buzz Bombers, Chase, Cloudy Mountain, Loco Motion, Mission X, Mystic Castle, Sharp Shot, Solar Sailer, Space Shuttle, Vection, Winter Olympics. **ACTIVISION:** Happy Trails, Pitfall, Stampede. **C.B.S.:** Blue Print, Carnival, Donkey Kong, Gorf, Mousetrap, Smurf, Solar Fox, Turbo, Venture, Wizard of War, Zaxxon. **IMAGIC:** Beezer, Dracula, Ice Trek, Nova Blast, Safecracker, Swords & Serpents, Tropical Trouble, White Water. **PARKER:** James Bond 007, Lord of the Rings, Popeye, Q Bert, Spiderman, Star Wars, Super Cobra, Tutankham.

COMPUTER KEYBOARD: In July/August 1983, Mattel will be launching their new £89, 49-key computer keyboard attachment called 'Lucky' which is fully programmable and has microsoft basic built in. It will transform your Master Component into a home computer. The adaptor also accepts a 6 note polyphonic music synthesiser and full size 49-key piano keyboard that will make learning music as easy as playing games.

MATTEL + VOICE — £85.22 + VAT = £98.00

£98

VIDEO GAME CLUB

In a fast moving market like video games, it is difficult to keep up to date with all the developments that take place. With new programmes and accessories being introduced at a fast rate by several different manufacturers, it is impossible to get all the information you require from one manufacturer alone. It is for this reason, that we have set up owners clubs for the more popular video games and home computers, to keep you fully up to date with what is going on with your particular machine. As far as we know, Silica Shop are the only company to offer such clubs, but that is not surprising since we are the specialists. We currently have **FREE** clubs for the **Atari VCS, Atari 400/800** home computers, and **Mattel Intellivision**. Soon we will have clubs for **Colecovision, Aquarius** and **Vectrex**. So if you own one of these machines, fill in the coupon opposite, and we will enrol you **FREE OF CHARGE** in the club relevant to your computer or video game.

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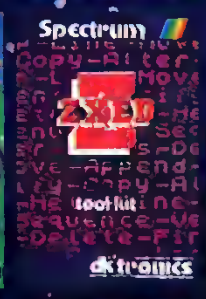






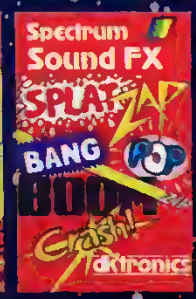




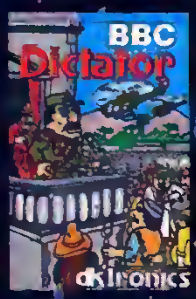










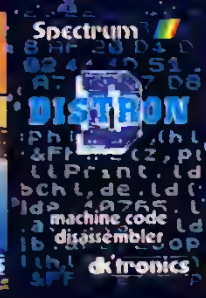














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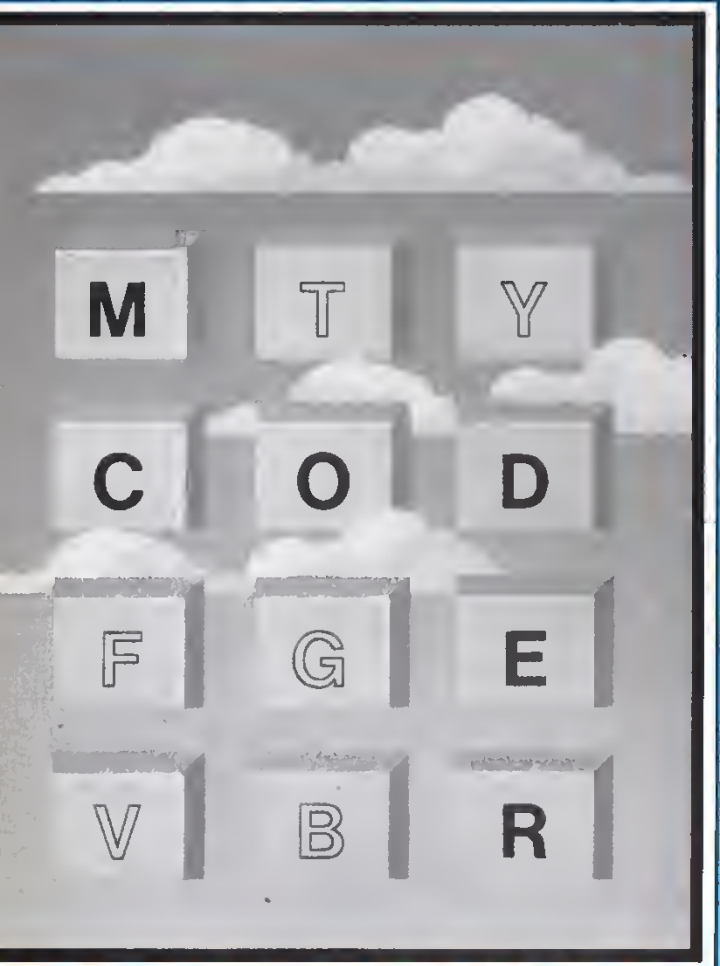
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PSS....THE FUTURE MAKERS INTRODUCE

M CODER II

The ultimate integer basic compiler for the 48k Spectrum and 16k ZX81 Instantly turns your basic into machine code at the touch of a key!



After the huge success of M Coder (THE original compiler for the ZX81 and Spectrum) we have gone one stage further and improved it to make programming even easier!!

M CODER II now handles STRINGS (NOT string arrays) as well as 95% of all integer basic, and we have made it *even* easier to use.

The list of commands are too long to print here — but we are so sure that *you* won't be disappointed, we are prepared to offer a NO-QUIBBLE GUARANTEE.

If *you* are not completely satisfied, return *M* CODER II within 7 days from date of purchase and *your* money will be refunded in full — without question.

SEND PSS A CHEQUE OR P.O. TO THE VALUE OF £9·95 FOR THE SPECTRUM VERSION OR £8·95 FOR THE ZX81 16K VERSION AND WE WILL SEND THIS REMARKABLE NEW PRODUCT TO YOU BY RETURN POST.

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Assembler/Disassembler ORIC-1

The assembler follows standard 6502 conventions and has proved very reliable while in continual use by Durell Software. Features include the following:

Generally	*List File*	*Pseudo-Op*
Auto line numbering	LIST	EQUATE
Six character labels	DELETE	BYTE
Updatable list-file	LLIST	DBYTE
Maths on operands	ALTER	WORD
Syntax checking	INSERT	TEXT
Output to printer	END/STOP	BLOCK

The disassembler also allows output to either screen or line-printer. The tape comes complete with comprehensive instructions. *£6.95*

Harrier Attack ORIC-1 and SPECTRUM

Pure machine-code, super-fast, action-packed, highly addictive arcade-style game requiring great skill. The harrier takes-off from an aircraft-carrier and flies over seaborne defences to attack enemy installations on a nearby island. The harrier may fly faster, slower, higher or lower, and has bombs and rocket fire with which to protect itself and make its own attack. If it flies too high it is detected by enemy jet-fighters (which it may counter-attack) – so it needs to hug the mountainous terrain which also varies with every new game. But the island is heavily defended by anti-aircraft rockets and tanks, which again the harrier may counter-attack or try to fly through. A tally is kept of fuel, bombs and rockets, plus player score and high score. Finally the harrier must make its bomb-run over the enemy base before returning to its own carrier. *£6.95*

Starfighter ORIC-1 (48K only)

You are in command of a galactic defence vessel travelling through time and space to attack and destroy intruding aliens. At long range this is carried-out on your computer scanner which displays stars in the local quadrant, with passing planets, space stations, time-gates, and of course the aliens which may strike in packs or singly, scattering anti-matter mines around your ship. You may counter-attack the aliens with your photon torpedoes, or if you move-in close enough switch over to manual and visual control to chase the fleeing alien and blast him with your phasors. See the star-scape spin relative to your ship's manoeuvres, but watch-out for the alien mines whizzing past. You will need to conserve energy carefully to get back to the refuelling points, and then the time-gates to the other quadrants. Weapons, shield and energy status are all monitored throughout this pure machine code game, which may be set to nine levels of skill. *£6.95*



Lunar Lander/Asteroids ORIC-1

Aimed at the newcomer to BASIC and/or the Oric-1, these exciting and enjoyable games are also easy to learn from, being short, simple and clearly written. Each is followed-up by a second version where every line of the BASIC is explained in an English REMark statement. These games also give a useful guide to the Oric's screen attributes. *£5.95*

Price includes postage, packing and VAT
Overseas customers please add £1 extra for postage outside UK

Dambuster LYNX

Can you fly your bombers through the enemy flak to make your drop from the right height, speed and distance so that your bouncing bomb finally sinks just behind the dam? This is a game that demands both skill and timing; but more than that it also helps teach you to write games for yourself, as every line of the BASIC program is explained in English in two follow-up versions of the game. Features include:

Dambusters' theme tune
Three planes and three dams
Bomber flies higher, lower, faster or slower
Random anti-aircraft fire
Bomb bounces relative to height and speed of drop
Dam crumbles and water floods through
Player score plus high score *£6.95*

Jungle Troubles SPECTRUM

Pure machine code with super cartoon graphics. This original and witty game is set in the depths of the African jungle. First you must direct your man to collect an axe and cross a nearby river via stepping stones that protect him from a lurking crocodile. Then he must climb a ladder to the next level, where he has to fell a number of trees in his path. As he does this a marauding ape appears from the left of the screen and steals his axe! So back to the start for another axe and more problems with the crocodile! And the ape! Having hacked a path through the forest he may climb another ladder to level three where he has to leap a pit of flames by grabbing a swinging rope. Will he ever escape back to the city? Can he jump the chasm that suddenly opens before him just as he is about to reach home? A highly amusing game with delightful graphics suited to all members of the family – but very frustrating and addictive. *£6.95*

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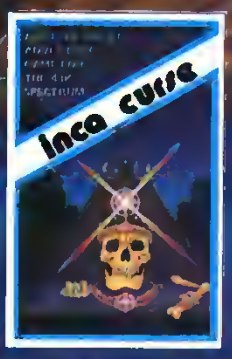
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A



16/48K ZX/Spectrum
16K ZX81
You find yourself stranded on a strange alien planet. Your aim is to escape by finding your captured space craft. But beware of the little green man who may get to you!

B



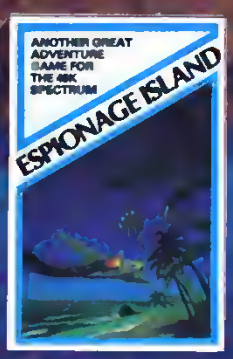
48K Spectrum
16K ZX81
You are in the middle of a South American jungle when you stumble across a strange Inca temple. Enter it to collect treasure and then try to return. But beware don't let greed be your downfall.

C



48K Spectrum
16K ZX81
While on a reconnaisance mission you are drawn to an alien cruiser on a humanoid slave mission. Try to escape from aggressive aliens, luscious androids and drunken barmen. Your only help is Fred the friendly android.

D



48K Spectrum
16K ZX81
You have to survive an engine failure while flying over an apparently uninhabitated island in the South Atlantic. Use your wits to harass the enemy, but treat the beautiful native women with respect, to escape from the island and return to an allies aircraft carrier.

WARNING: These programs are sold according to ARTIC COMPUTING LTD's terms of trade and conditions of sale. Copies of which

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_____

_____

_____

*Tick, delete or complete as applicable

(continued from page 159)

this, entering 16514 as the start address then type in all the code as in listing 2. When you have done that, type Stop and run the code loader again, entering the start address for listing 3. Do this for all the machine code routines.

The delete the code loader and enter the Basic part of the program — listing 6. You may then Run the program.

The master program calls the other three routines and returns to Basic. By calling the master program over and over from Basic, the action is continuous.

Basic program notes

1 to 4	contains the machine code
5	sets up initial length of worm
7 to 14	sets up obstacles
20 to 24	sets up display
90 to 96	stores location of base on screen into 16507 and 16508
110	puts base on screen
115	puts worm on screen
120	calls machine code and checks if 1 is pressed
125	loops round
130	shows reaction to key 1
135 to 140	sees if worm has landed
150	increases size of worm
160	starts next level
200 to 230	game over.

When you run the program several obstacles should appear. Then a border is printed and a one-segment worm appears at the top of the screen. This will start to move, descending one line when it hits an obstacle.

Your base at the bottom of the screen is moved right and left with I and T. Key 0 fires a missile. You must try and destroy the worm before it hits the ground.

If you do, press 1 and hold it down until the computer reacts. You will then move to the next level with a two-segment worm and more obstacles.

You can shoot most obstacles though some are indestructible. If the worm lands, you will have to hold down key 1 until the computer reacts and then the game is over.

The worm will not more into your missile from the side. You must shoot it from underneath. Sometimes the worm splits into many parts, making it very difficult to destroy, but you must cope as best you can.

Listing 1

```
9000 PRINT "START ADDRESS?"
9010 INPUT R
9020 FOR F=R TO 4E4
9030 INPUT P
9040 POKE F,P
9050 SCROLL
9060 PRINT F,P
9070 NEXT F
```

Listing 2.

```
16514:17 33 0 42 12
16519:64 35 126 254 25
16524:200 254 8 40 7
16529:254 136 40 32 195
16534:136 64 64 0 35
16539:126 254 0 32 5
16544:54 8 195 136 64
16549:25 43 126 254 0
16554:32 5 54 136 195
16559:136 64 237 82 24
16564:247 54 0 43 126
16569:254 0 32 5 54
16574:136 195 136 64 25
16579:36 126 254 0 32
16584:8 84 8 195 136
16589:64 237 82 24 247
```

Listing 3.

```
16613:17 66 0 42 123
16618:64 58 37 64 254
16623:258 200 254 239 32
16628:9 237 82 126 254
16633:14 200 64 14 201
16638:254 223 32 16 54
16643:0 35 126 254 0
16645:32 7 54 35 237
16653:99 123 64 201 43
16655:24 246 254 251 32
16663:248 54 0 43 126
16668:254 0 32 7 54
16673:38 237 99 123 64
16678:201 35 24 246
```

Listing 4.

```
16715:17 33 0 42 12
16720:64 35 126 254 25
16725:200 254 14 32 247
16730:54 0 237 52 126
16735:254 131 40 6 254
16740:0 32 6 54 14
16745:25 195 51 65 254
16750:6 40 14 254 136
16755:40 10 254 149 32
16760:2 24 239 54 0
16765:24 234 54 149 24
16770:230
```

Listing 5.

```
16793:6 10 205 130 64
16798:205 229 64 205 75
16803:65 16 245 201 61
```

Listing 6.

```
   5 LET R$="■"
   7 FOR N=1 TO 3
   6 PRINT AT RND*16,RND*25;"■■■
■";( TO INT (RND*6)+1)
   9 LET P=RND*30
  10 PRINT AT RND*13,P;("■" RND
LEN R$=1)+("■" RND LEN R$>1)
  11 FOR M=1 TO RND*4
  12 PRINT TAB P;"■■■
   "(INT (RND*LEN R$)+1)
  13 NEXT M
  14 NEXT N
  20 PRINT AT 21,0,"■■■
```

Why the BBC Micro? It might be fairer to let someone else answer that question.

"The BBC Microcomputers are the limousines of home computers. The graphics are prohahly the hest of any machine in this class. You are paying for a smart machine which would not disgrace the home of a professional."
Video World, Feb. '83.

"Its design has given the BBC Micro an unrivalled potential for husiness, educational and serious home applications. It has heen equipped to function as the heart of a system which can he expanded to suit its owner's need."
Which Micro & Software Review, Feb. '83.

"The most attractive and exciting feature of the BBC Microcomputer is its enormous potential for expansion which will allow a highly expansive system to he huilt-up."
Debornh Carruthers, Which Micro, June '82.

"They (the graphics) are tremendously exciting, and they are one of the features that make this machine stand out head and shoulders ahove everything else that is availahle in the market place at this time."
Dave Futcher, Educational Computing, Mny '82.

"It is expandahle and has a powerful BASIC. It has superh sound and graphics, the software is readily availahle and the price is right."
Mr. A. D. Alles, a BBC Micro owner from Hnmpshire.

"The hasics are easy to follow. My wife has developed a program for teaching our daughter French vocahulary. Our daughter uses it mainly for games and simple programming."
Dr. A. Yarwood, a BBC Micro owner from Co. Durhnm.

"It is a very powerful computer. My hushand has written his own data hase. I have heen writing programs and programming games. Even the children have written small programs."
Mrs. A. M. Thomas, a BBC Micro owner from Devon.

"No other computer can offer such ease of use when dealing with complex sound effects."
Which Micro, June '82.

"It isn't often a journalist can sit down to write ahout a computer with the certain knowledge that he has never seen a nicer machine."
Guy Kewney, Personal Computer World, Dec. '82.

"It has got huge potential. Besides playing the games, the whole family are learning hasic programming."
Mr. P. S. Green, a BBC Micro owner from Staffordshire.

"Everything possihle seems to have heen done to ensure that this is not a 'dead end' machine..."
Paul Beverley, Personal Computer World, July '82.





Perhaps we could just add that the BBC Micro is the machine which was chosen to be at the heart of the BBC's massive Computer Literacy Project.

It is also the machine which, having won the Department of Industry's blessing, will account for over 80% of the computers bought by British schools this year.

And now for some facts about the machine itself.

The BBC Micro is light, compact and, with a conventional electric typewriter keyboard, easy to get the feel of.



It can be loaded from virtually any cassette recorder. And there is a wealth of ready-made programs available covering games, education and business subjects.

The BBC Micro uses BBC BASIC, a sophisticated version of the most popular computer language.

However, as your confidence and fluency grow, it can be adapted to switch to other languages.

It can also become a word processor, with the facility to link with a second processor for high-powered business use.

A disc drive unit can also be added. And with an adaptor, the BBC Micro is the first micro to be able to pick up programs from the Micronet–Prestel system. Another adaptor converts your TV into a Teletext receiver, with further ability to download programs.

All this for only £399.

The most sophisticated version of the BBC Micro, the Model B, is only £399. The basic Model A is £299. (Both come with a "Welcome cassette" and comprehensive introductory manual.)

They are both available from John Lewis, selected branches of Boots or local stockists.

Alternatively, if you would like to order a BBC Micro B with your credit card, or if you want the address of your nearest stockist, just phone 01-200 0200.

Or, you can buy a Model B by sending off the order form below to: BBC Microcomputers, c/o Vector Marketing, Denington Estate, Wellingborough, Northants.

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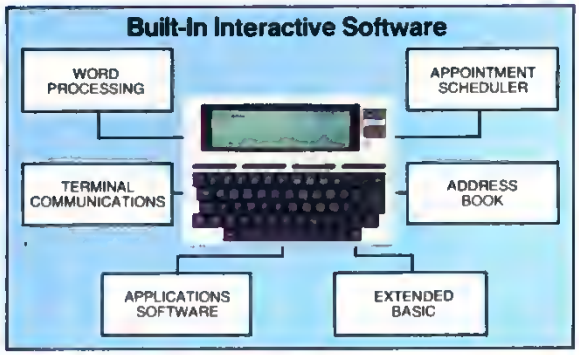


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YC1

(continued from page 167)

```
250 CLS:GOSUB590  TITLE
260 GOSUB640  INSTRUCTIONS REMINDER
270 GOSUB 710  TEMPO
280 GOSUB760  BEAT
290 TIMER=0
300 C$=INKEY$:IF C$<>"" THEN380
310 IF TIMER<BEAT THEN 300 ELSE STRESS=ST+1:TIMER=0:IF
 STRESS=ISTRESS THEN DU=DU+2:ST=0
320 GOSUB 950
330 SOUND P1,DU:DU=MD
340 GOTO300
350  *************************
360   ALTER TEMPO & STOP METRONOME
370  *************************
380 IFC$=CHR$(8) OR C$=CHR$(9) THEN GOSUB 820
390 IF C$=" " THEN GOSUB910
400 GOTO 300
410 END
420  *************************
430  INITIALISATION
440  *************************
450 DIMT$(13),F$(13),T(13)
460 FORA=1TO13:READ T$(A),T(A)
470 IFLEN(T$(A))>9 THEN F$(A)=LEFT$(T$(A),2)+"'"+RIGHT
$(T$(A),6) ELSE F$(A)=T$(A)
480 NEXT A
490 DATAGRAVE,40,LENTO,42,LARGO,44,LARGHETTO,48,ADAGIO
,52,ANDANTE,60,MODERATO,80,ALLEGRETTO,99,ALLEGRO,116,V
IVACE,126,PRESTO,144,PRESTISSIMO,184,DUMMY,999: TO ALL
OW FASTER TEMPI SANS CRASHING'
500 PITCH=100
510 MDURATION=1:DURATION=1
520 M1=172:M1$=CHR$(159)+"   "
530 M2=205:M2$=CHR$(134)+" "
540 M3=172:M3$="   "+CHR$(159)
550 M4=205:M4$=" "+CHR$(137)
560  *************************
570  TITLE
580  *************************
590 PRINTB43,"METRONOME
600 RETURN
610  *************************
620  INSTRUCTIONS
630  *************************
640 PRINTB322,"TO SLOW IT DOWN,PRESS <- KEY
650 PRINTB354,"TO SPEED IT UP,PRESS -> KEY
660 PRINTB488,"PRESS spacebar TO PAUSE"
670 RETURN
680  *************************
690   TEMPO
700  *************************
710 PRINTB263,T$(B)
720 RETURN
730  *************************
740   BEAT
750 '*************************
760 PRINTB276,BM
770 BEAT=INT(3000/BM)
780 RETURN
790  *************************
800   ALTER DISPLAY OF TEMPO & BEAT
810  *************************
820 IFC$=CHR$(9)THEN BM=BM+1
830 IFC$=CHR$(8) THEN BM=BM-1
840 IFBM=>T(B+1) THENB=B+1:GOSUB710
850 IF BM=<T(B-1) THEN B=B-1: GOSUB 710
860 GOSUB760
870 RETURN
880  *************************
890   PAUSE
900  *************************
910 PRINTB322,,," PRESS spacebar TO CONTINUE"," PRESS
 enter TO RETURN TO TABLE"," "
920 C$=INKEY$:IF C$="" THEN 920 ELSE IF C$=" "THEN GOS
UB 640: RETURN
930 GOTO 70
940 '*************************
950 '    GRAPHICS
960  *************************
970 IF FL=0 THEN PRINT@M1,M1$:PRINT@M2,M2$:FL=1: ELSE
PRINT@M3,M3$:PRINT@M4,M4$:FL=0
980 RETURN
990 END
```

Instant command

A D Robinson,
Wath-on-Dearne,
South Yorkshire.

SPECTRUM

WHEN USING COMPILERS or disassemblers, or when developing a Basic program, it is often necessary to repeatedly make the same command. For example,

RAND USR 40000, SAVE "DEMO"

This can be very monotonous. This program listing for the 16K or 48K Spectrum enables the user to define a specific key or shifted key to give this command instantly.

The command to be defined is entered as line 1 of the program and is then edited and a Rem statement is inserted at the beginning. It can be changed as and when necessary.

Enter either the 16K or 48K listing, Save it, then Run it. When the machine code has been entered the program will ask for the code of the trigger key. This can be entered as a number from the list of codes at the back of the Spectrum manual or by entering, for example, Code"Z". Obviously choose a key that will not be needed. The program will then execute New and disappear, but the routine is now working.

Now type in

1 PRINT "This is an Example"

Press enter, the edit the line and inset the Rem statement before the word print. Now press enter again. To test the program press the chosen trigger key/keys and line 1 will be recreated at the bottom of the screen as a direct command and will be executed. It is best to stick to single statements in line 1 as multi-statement lines sometimes produce a syntax-error.

Another use for the routine is to prevent the accidental pressing of the New key. Enter 230 as the trigger code, enter 1 Rem Goto 9999, the line 9999 as Input 2$: IF 2$="Yes" then New. If the New key is then pressed, the program will check to see if you really mean it. To return to normal and switch off the defined key facility, simply type

RAND USR 65100 (32319 for 16K)

The program works by altering the interrupt mode of the Spectrum so that every 1/50 second it calls our machine-code routine. This routine looks at the system variable Last K and, if it is the trigger key, it jumps to the routine to change this. The program starts with the byte after the Rem statement and enters this into Last K.

It then sets bit 5 of system variable flags to fool the machine into thinking a new key has been pressed. A pointer is then incremented so that, on the next interrupt, the following byte is entered, and it keeps on doing this until the Enter character is found to indicate the end of the line. The pointer is then reset.

Remember to switch the routine off before overwriting any of the code used by the program.

```
  1 REM PRINT "16K Example"
 10 CLEAR 32316: PRINT AT 10,10
,"STAND BY"
 20 DATA 62,62,237,55,237,71,20
1,0,0
 30 DATA 62,45,237,71,237,94,33
,205,92,34,90,126,201,0,0,0,0,0,
0
 40 DATA 255,243,245,229,42,90,
126,125,254,205,32,6,33,8,92,126
,254,95,32,34,42,90,126,125,35,3
4,90,126,33,6,92,119,58,59,92,20
3,238,33,59,92,119,56,6,92,254,1
3,32,6,33,205,92,34,90,126,226,2
41,251,201
 50 FOR b=32319 TO 32405  REMO
b  POKE a,b  NEXT a
 60 CLS  PRINT "CODE of trigge
r key ?"
 70 INPUT z  POKE 32365,z
 80 RANDOMIZE USR 32329  NEW
 81 REM RANDOMIZE USR 32319 TO
STOP
```

```
  1 REM PRINT "This is an Examp
le"
 10 CLEAR 55099  PRINT AT 10,10
,"STAND BY"
 20 DATA 62,62,237,55,237,71,20
1,0,0
 30 DATA 62,9,237,71,237,94,33,
205,92,34,103,254,201,0,0,0,0,0,
0
 40 DATA 255,243,245,229,42,103
,254,125,254,205,32,5,33,5,92,12
6,254,95,32,34,42,103,254,125,35
,94,103,254,33,8,92,115,56,59,92
,203,230,33,59,92,119,55,5,92,25
4,13,32,6,33,205,92,34,103,254,2
25,241,251,201
 50 FOR b=55160 TO 55166  REMO
b  POKE a,b  NEXT a
 60 CLS  PRINT AT 10,4,"CODE o
f trigger key ?"
 70 INPUT z  POKE 55145,z
 80 RANDOMIZE USR 55110  NEW
```

Kippax Stock Market

Charles W Peel,
Leeds.

ATOM

KIPPAX MAY NOT BE the biggest village in England but it can now boast about this fun stock market game which bears its name. The game is ideal for gatherings of up to nine people. This limitation is only due to the presentation which is available on the Atom. I personally organise the party so that one person is the keyboard operator to interpret the wishes of individual players.

The initial screen introduces the market and the players are requested to determine the number of rounds they wish the game to consist of, and also their respective *nom de plumes* in the order they wish to play. Each *nom de plume* can be up to nine characters including any full stops or spaces.

The Atom then displays the current state of the market in respect of six commodities — gold, tin, silver, copper, lead and plastics. The details which follow are:

■ The actual quote for each commodity expressed in pence.

■ The realisable value of each share after deducting 10 percent for each sale.

■ The cost of each share after including the charge of 10 percent for each purchase.

Columns two and three are only expressed to three significant figures, so beware of rounding traps.

■ When the time is due — see column six — the shares will pay out dividends determined in a random manner from 20 to 120 pence per share. Catching the high dividends is the sure way to make your fortune and win the game.

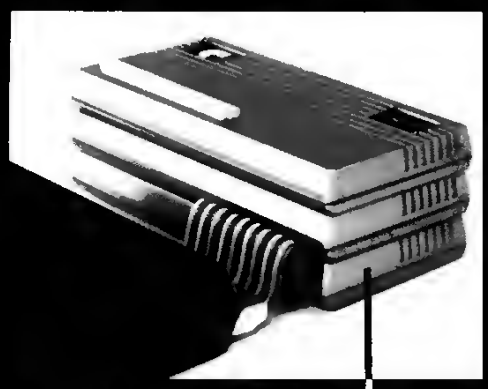
■ The market makes available 999 shares in each commodity and this column informs you how many are available for purchase.

■ Each commodity is initially given a number which is determined by the number of players taking part. This indicates the time left to the next dividend pay out. This number is reset after a pay out so that you have to make a judgment — when to buy or sell.

The lower part of the screen then displays the state of the player whose turn it is to play.

(continued on page 173)

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(continued from page 171)

Displayed are the cash in hand initially set to £200, the number of shares of each commodity held and the potential worth of the player should he be able to sell all his holdings.

The final line displays action and this is where the transactions are entered. Each player is allowed up to four transactions per turn but only one of them may be a sale. The actions available are:

B — Buy
S — Sell
N — Next player please

after B or S the next character must be from the following:

G — Gold
T — Tin
S — Silver
C — Copper
L — Lead
P — Plastics

followed by the number of shares to buy or sell.

Beware. If you miscalculate, the Atom will display a cryptic remark and terminate your turn by calling up the next player. When the entry is complete press the space-bar and the Atom will revise your current state due to this action.

After each player's turn the current state of all players is displayed in the form of cash in hand and potential worth, as well as the number of rounds remaining in the game. This is important to watch because at the end of the game only the cash in hand is considered to determine the winner. Because only one sale may be made in any one round, if you do not sell your shares at the right time you may loose their value.

When all players have had an equal number of turns — that is the end of each round their names are sorted into the sequence of the cash in hand held. The potential value is also displayed. In this manner it is possible to judge your current performance against all the others. Best wishes for happy marketeering.

```
10L=&82C0 E=&8200 F=&8218 G=&8230 D=&8260 T=&8248
20M=&80 N=&81 O=&82 P=&8B S=&83 N=&8B R=&8A DIMLL5
30F.I=0TO5 LLI=&9000 N.I P.~$8~$15~2I F.I=0TO1 P=&9000
40E LL0 JSR&FFE6 STAM PTS
50 LL4 ADC&84 STA&84 STA0 LDA#0 ADC&85 STAC&85 STA&89 JMPLL3
60 LL2 LDA&84 ASLA STA&84 LDA&85 POLA STA&85 PTS
70 LL1 LDA#0 STA&B4 STA&85
80 LL3 JSPLL2 STA&87 LDA&84 STA&86 JSPLL2 JSPLL2 LDA&84
90 ADC&86 STA&84 LDA&85 ADC&87 STA&85
100 LL5 JSP&FFE3 CMP@13 BEQLL5 JSP&FE52 JMP&F87E
110 BCCLL4 PTS J N.I
120aP.$@$12 P."      KIPPAX STOCK MARKET"
130IN."NO.OF ROUNDS TO END "Z P.'
140IN."NO.OF PLAYERS "A J=0 @=0 F.I=0TO A N?1=I N.I I=0
150P.$12"      KIPPAX STOCK MARKET"''
160DOP,"NAME OF PLAYER NO."(I+1) IN.$B B=B+LENB+1 L!J=20080
170F.K=J+4TOJ+28 STEP4 L!K=0 N.K J=K I=I+1 U.I=A
180F.I=0TO20 STEP4 E!I=100 F!I=999 G!I=8*A T!1=0 N.I
190D=0 B=&8260 @=4
200bP.$12"       KIPPAX STOCK MARKET"
210P."          ACT @ID OFF DIV BNK POS"
220P."90LD    ";?0=0 GOS. J P."tIN     ";?0=4 GOS.'
230P."SILVEP  ";?0=8 GOS. I P."COPPER  ";?0=12 GOS. J
240P."LEAD    ";?0=16 GOS. K P."PLASTICS ";?0=20 GOS. L
250P." CURRENT ACCOUNT FOP "?"CASN IN HAND"
260P."90LD"DOP," " U.C.=14 P."tIN"
270P."SILVEP",DOP," ";U.C.=14 P."COPPER"
280P."LEAD",DOP," ";U.C.=16 P."PLASTICS"
290P."TOTAL ASSETS",DOP," ",U.C.=20 P.'"ACTION " C=0 Y=0 G.h
300CLt.LL0 IF?M=CH"B" P."uy ",?N=?M C=C+1 G.d
310IF?M=CH"S" P."ELL ",?N=?M C=C+1 Y=Y+1 G.d
320IF?M=CH"N" P."EXT PLAYER" G.I
330P.$8" "$B G.c
340dIFC>4 G.u
350IFY>1 G.t
360LI.LL0 IF?M=CH"G" P."OLD ";?0=0 G.e
370IF?M=CH"T" P."IN ";?0=4 G.e
380IF?M=CH"S" P."ILVER ";?0=8 G.e
390IF?M=CH"C" P."OPPER ";?0=12 G.e
400IF?M=CH"L" P."EAD ";?0=16 G.e
410IF?M=CH"P" P."LASTICS ";?0=20 G.e
420P.$0" "$B G.d
430eLI.LL1 IF?N=CH"0" G.f
440IF(L!(D*32+(4+?0))-(256*(0?1)+?0))<0 G.w
450I$=((E!(?0)*256+(0?1)+?0)*9)/10 G.g
460F!S=((E!(?0)*256+(0?1)+?0)*II)/10
470IF(F!(?0)-(256*(0?1)+?0))<0 G.w
480IF!S)L!(D*32) G.x
490F!(?0)=(F!(?0))-(256*(0?1)+?0) L!(D*32)=(L!(D*32))-!S
500L!(D*32+(4+?0))=L!(D*32+(4+?0))+(256*(0?1)+?0) G.h
510F!(?0)=(F!(?0))+(256*(0?1)+?0)
520L!(D*32+(4+?0))=(L!(D*32+(4+?0)))-(256*(0?1)+?0)
530L!(D*32)=(!S)+(L!(D*32))
540F.I=8TO6 P.$11 I.N J P.' DOP.$9 U.C.>20 P.$B DOP." ",U.C.>30
550P.' DOP.$9 U.C.=13 J=L!(D*32) GOS.m P.'
560DOP.$9 U.C.=9 P.L!(4+D*32) DOP.$9 U.C.=26 P.L!(8+D*32)
570P.' DOP.$9 U.C.=9 P.L!(12+D*32) DOP.$9 U.C.=26 P.L!(16+D*32)
580P.' DOP.$9 U.C.=9 P.L!(20+D*32) DOP.$9 U.C.=26 P.L!(24+D*32)
590P.' DOP.$9 U.C.=14 J=L!(D*32) GOS.n GOS.m P.'
600DOP.$9 U.C.=7 DOP." ";U.C.=25 P.$13 DOP.$9 U.C.>32 G.c
610lU=B V=D D=0 B=&8260 P.$12"TABLE OF CURRENT PLAYER VALUES"'
620DOP." ",U.C.=13 P."ASSETS"'
630DOP.$B DOP." ",U.C.=12 J=L!(D*32) GOS.n GOS.m P.' B=B+LENB+1
640D=D+1 U.D=A B=U D=V B=B+LENB+1 D=D+1 IFD=A D=0 B=&8260
650GOS.r L1.LL0 tFD=0A Z'>I GOS.o GOS.r LI.LL0 G.b
66BtFD'>0 G.b
670GOS.o P."THANK YOU FOR PLAYING"'
680IN."DO YOU WISH TO PLAY AGAIN"$B tF?B=CH"Y" G.a
690E.
700 G!(?0)=G!(?0)-(A.P.%6+1) T!(?0)=0
710tFG!(?0)<0 T!(?0)=0-(20*G!(?0))) G!(?0)=8*A G.l
720kIFG!(?0)%5=0 E!(?0)=E!(?0)-2
730tFG!(?0)%5=1 E!(?0)=E!(?0)-1
740IFG!(?0)%5=3 E!(?0)=E!(?0)+1
750IFG!(?0)%5=4 E!(?0)=E!(?0)+2
760P.E!(?0) E!(?0)*9/10 E!(?0)*11/10 T!(?0) F!(?0) G!(?0) P.
7701I=0 DOL!(I*32)=L!(I*32)+((L!(I*32+(?0)+4))*(T!(?0)))
780I=I+1 U.I=A G.k
790P.(J/100) @=0 P.".",IF(J%100)<10 P."0"
800P.(J%100)"   " @=4 R.
810nF.I=0TO20STEP4 J=J+((L!(4+1+D*32))*(E!I)*90)/100 N.I R.
820P.$12"      BIG SPENDERS LEAGUE" "NO.OF ROUNDS LEFT "
830D=0 Z=2-I P.Z' DOP." ",U.C.=12 P."CASH      TOTAL"
840DO J=L!(D*32) GOS.n L!(D*32+28)=J D=D+1 U D=A W=A-1
850DO %=0 DO IFL!(H?X)*32)<L!((H?X+1))*32) GOS.9
860X=X+1 U.X=W W=W-1 U.W=0 DO B=&8260 IFH?W=0 G.P
870F.I=1TOH?W B=B+LENB+1 N.I
880@P.$B DOP." ",U.C.>9 J=L!((H?W)*32) GOS.m
890J=L!((H?W)*32+28) GOS.m P.' N=W+1 U.W=A DO=0 B=&8260 R.
900a?P=H?X H?X=H?(X+1) H?(X+1)=?P F.
910rP.'"NEXT PLAYEP - "$B'"PRESS SPACE BAP TO CONTINUE"' P.
920sF.I=0TO5 P.$11 N.I P.' F.I=0TO2 DOP." ",U.C.>30 P.', N.I P.
930tGOS.s P."SORRY - ONLY ONE SALE ALLOWED" G.y
940uGOS.s P."GREEDY - TOO MANY TRANSACTIONS" G.y
950vGOS.s P."YOU HAVEN'T ONL"(L!(D*32+(4+?0))" UNITS" G.y
960wGOS.s P."ONLY "F!(?0)" UNITS AVAILABLE" G.y
970xGOS.s P."YOU HAVEN'T GOT ENOUGH - SORRY"
980yF.I=0TO300 WAIT N.I G.i
```

Padcalc

B R Law,
Leicester.

3K-31

PADCALC IS A general-purpose mathematical program that will allow up to five formulae to be entered for subsequent calculation. It is most useful when only a limited number of "what if?"-type calculations are required, and under these circumstances it is easier to set up than a spreadsheet program and the format is more readily understandable.

In general terms using Padcalc is the computer equivalent of paper and pencil because it works in the same way you would if working through a formula or series of formulae. It initially asks you to enter your formula containing all of its variables. When you have entered your last formula press Newline and it will list all the variables for which it requires you to enter values. You will notice that it does not ask for a variable if this has been calculated previously or if the same variable was used in a previous formula.

The cursor over the variable letter indicates that it is waiting for you to enter a value against this letter; when this is done it moves to the next variable. When the last variable is entered the results are automatically calculated and printed below the variables.

At this stage the cursor over the last variable letter begins to flash, indicating that you can now change the value of one of the variables. The cursor can be moved up and down in response to the cursor keys 6 and 7 and when key V is pressed a new value for the variable on which the cursor sits, can be entered.

Variables can continue to be changed in this manner until key C is pressed. A new set of results are then calculated and the result is printed adjacent to the first set. This process can be continued until four sets of variables and results are printed on the screen. Any further changes will result in the screen being cleared and the next set of results are printed down the first row.

A warning that this will happen is given at the bottom of the screen after four sets of results have been calculated. The following types of functions can be used in the formula: +, -, *, /, **, E, Sin, Cos, Tan, Asn, Acs, Atn, Rnd, Int, Sqr, PI, Abs

There are, however, certain constraints that should be applied when entering a formula, and they are as follows.

No more than five formulae may be entered at any one time.

Variable names should be no more than two characters long and if numerics are included they should be put after an alphabetic character. For example, A1, V2 and so on.

When using trigonometric functions a single alphabetic character only can be used and any angle must be given a variable name. A numeric angle will not be accepted in a formula. For example Sin 30° should be entered as Sin A. The angle can then be entered as a variable.

All angle variables should be entered as

(continued on page 175)

[illegible] Present



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YC8

(continued from page 173)

decimal degrees. For example, Sin 30° 30' should be entered as Sin 30.5°.

All answers involving degrees are given in decimal form.

When using the functions Sin, Cos and Tan the variable which the function acts upon has initially to be multipled by π/180 to change degrees to radians. In cases where the variable has no brackets around it the π/180 is inserted immediately after the function by the program. When brackets are present π/180 is inserted inside the first bracket. Therefore, if brackets are required always put on an additional set. For example, Sin A; Sin (A×B); Sin ((A+B)).

Now an example to clarify the entry procedures. This example uses the program to calculate various features of a gear. The variables used are defined as follows:

PD = Pitch circle diameter
DD = Outside diameter
RD = Root diameter
TT = Tooth thickness
N = Number of teeth
DP = Diametrical pitch

After loading the program using Load "Padcalc" you should receive a prompt asking for the first formula. Proceed as follows:

PD = N/DP ➤N/L
DD = PD + 2/DP ➤N/L
RD = DD − 2×2.25/DP ➤N/L
TT = 1.5708/DP ➤N/L ➤N/L

The screen should now have a black cursor visible over the letter N. Now enter the value for N, for example 45 ➤N/L. The cursor jumps to DP so enter a value for this, for example, 11 ➤N/L. After this last entry the answers are automatically calculated and displayed against their respective variables.

After this either of the two variables can be changed by shifting the cursor using keys 6 or 7 then pressing key V and entering the new variable. To see the new results press C for recalculation. For example, 7 ➤V ➤15➤ N/L ➤will recalculate the results with the number of teeth changed to 15.

```
  1 REM "PADCALC
  4 FRST
  5 DIM M$(5 50)
  6 DIM F$(5,130)
  7 DIM A(5)
  8 LET U$=""
  9 LET R$=""
 10 LET F=0
 11 LET KU=0
 12 LET DP=3
 13 LET FL=0
 50 REM [illegible]
 55 PRINT AT 21,0" FORMULA? PRE
SS N/L TO FINISH"
 65 LET F=F+1
 70 INPUT M$(F)
 75 IF M$(F,1)=" " THEN GOTO 1
0
 80 LET F$(F)=N$(F)
 85 GOSUB 500
 90 PRINT AT F-1,0,M$(F)
 95 IF F=0 THEN GOTO 110
100 GOTO 65
105 LET F=F-1
110 SLOW
115 LET V1=LEN U$/2
120 DIM V(LEN R$/2)
125 DIM P(V1)
130 DIM U(V1)
135 PRINT AT F,0 [illegible]
140 PRINT AT 21,0
145 FOR X=1 TO V1
150 LET P(X)=F+X
155 PRINT AT P(X),0,U$((X*2)-1
TO X*2)+"="
160 NEXT X
165 PRINT "**********
170 FOR Y=1 TO LEN R$/2
175 LET U(Y)=P(X-1)+1+Y
180 PRINT AT U(Y),0,R$((Y*2)-1
TO Y*2)+"="
185 NEXT Y
190 GOTO 800
500 REM [illegible]
501 REM [illegible]
505 LET X=0
510 LET X=X+1
515 IF F$(F,X)=" " THEN GOTO 57
0
517 IF CODE F$(F,X)>105 AND COD
E F$(F,X)<206 THEN GOSUB 700
518 IF F$(F,X)="E" AND CODE F$(
F,X-(X<>1))>26 AND CODE F$(F,X-(
X<>1))<35 THEN GOTO 518
520 IF CODE F$(F,X)>37 AND CODE
F$(F,X)<64 THEN GOTO 630
525 GOTO 510
570 IF CODE F$(F,X+1)<26 OR COD
E F$(F,X+1)>63 THEN LET F$(F)=F$
(F,1 TO X)+" "+F$(F,X+1 TO )
651 REM [illegible]
632 IF X=1 THEN GOTO 656
633 IF U$="" THEN GOTO 642
634 FOR Z=1 TO LEN U$*(LEN U$)=
LEN R$)+LEN R$*(LEN R$>LEN U$) S
TEP 2
635 IF Z+1>LEN U$ THEN GOTO 640
638 IF F$(F,X TO X+1)=U$(Z TO Z
+1) THEN GOTO 646
636 IF Z+1>LEN R$ THEN GOTO 641
640 IF F$(F,X TO X+1)=R$(Z TO Z
+1) THEN GOTO 646
641 NEXT Z
642 LET U$=U$+F$(F,X TO X+1)
645 LET X=X+1
650 GOTO 510
656 LET R$=R$+F$(F,X TO X+1)
660 GOTO 645
665 REM [illegible]
670 LET X=5
675 LET F$(F)="A("+STR$ VAL "F"
+")"+F$(F,3 TO )
680 LET X=X+1
685 IF F$(F,X)=" " THEN RETURN
687 IF F$(F,X)="E" AND CODE F$(
F,X-(X<>1))>26 AND CODE F$(F,X-(
X<>1))<35 THEN GOTO 660
690 IF CODE F$(F,X)>37 AND CODE
F$(F,X)<64 THEN GOTO 680
695 GOTO 680
600 LET Y=1
605 IF Y>LEN R$ THEN GOTO 625
610 IF F$(F,X TO X+1)=R$(Y TO Y
+1) THEN GOTO 545
615 LET Y=Y+2
620 GOTO 605
625 LET K=1
630 IF F$(F,X TO X+1)=U$(K TO K
+1) THEN GOTO 555
635 LET K=K+2
640 GOTO 630
645 LET F$(F)=F$(F,1 TO X-1)+"A
("+STR$ ((VAL "Y"+1)/2)+")"+F$(F
,X+2 TO )
650 GOTO 660
655 LET F$(F)=F$(F,1 TO X-1)+"U
("+STR$ ((VAL "K"+1)/2)+")"+F$(F
,X+2 TO )
660 LET X=X+4
665 GOTO 500
700 REM [illegible]
705 IF CODE F$(F,X+1)<>10 THEN
GOTO 740
710 IF CODE F$(F,X)>190 AND COD
E F$(F,X)<202 THEN GOTO 730
715 LET F$(F)=F$(F,1 TO X-1)+"1
60/PI*"+F$(F,X TO )
720 GOTO 765
730 LET F$(F)=F$(F,1 TO X+1)+"P
I/160*"+F$(F,X+2 TO )
735 GOTO 765
740 IF CODE F$(F,X)>196 AND COD
E F$(F,X)<202 THEN GOTO 760
745 LET F$(F)=F$(F,1 TO X-1)+"1
80/PI*"+F$(F,X TO )
760 GOTO 765
760 LET F$(F)=F$(F,1 TO X)+"(PI
/180*"+F$(F,X+1)+")"+F$(F,X+2 TO
)
765 LET X=X+7
770 RETURN
800 REM [illegible]
805 LET P5=PEEK (16396)+PEEK (1
6397)*256+1
810 LET PC=P5+((F+1)*33)
815 LET X=1
820 GOTO 845
825 LET PP=PC
830 IF FL=6 THEN GOSUB 1000
835 GOSUB 3000
840 POKE PP,PEEK (PP)-128
845 POKE PC,PEEK (PC)+128
850 GOTO 825
1000 REM [illegible]
1005 IF X>U1 THEN GOTO 2000
1010 INPUT U(X)
1015 PRINT AT P(X),4,U(X)
1020 LET PC=PC+33
1021 IF X=V1 THEN LET PC=PC-33
1022 LET X=X+1
1025 GOTO 840
2000 REM [illegible]
2002 LET FL=1
2005 FOR X=1 TO F
2010 LET R(X)=VAL F$(X,6 TO )
2015 PRINT AT U(X),4+KU,INT (R(X
)*(10**DP)+.5)/(10**DP)
2020 NEXT X
2022 LET KU=KU+7
2023 IF KU>=26 THEN PRINT AT 21,
0," NB SCREEN TO CLEAR"
2026 RETURN
3000 REM [illegible]
3010 IF INKEY$="U" THEN GOTO 310
0
3010 IF INKEY$="C" THEN GOTO 320
0
3020 LET PC=PC+((INKEY$="6")*33)
*(PC>(P5+(V1)*33))-((INKEY$="7"
)*33)*(PC>(P5+(F+1)*33))
3025 RETURN
3100 REM [illegible]
3105 LET Q=(PC-P5)/33)-F
3110 INPUT U(Q)
3115 IF KU>=26 THEN GOSUB 4000
3120 PRINT AT P(Q),4+KU,U(Q)
3125 RETURN
3200 FOR X=1 TO U1
3205 PRINT AT P(X),4+KU,U(X)
3210 NEXT X
3215 GOTO 3000
4000 REM [illegible]
4005 LET KU=0
4010 FOR X=F+1 TO U(F)
4015 IF X=P(U1)+1 THEN GOTO 4025
4020 PRINT AT X,5 "
4025 NEXT X
4030 PRINT AT 21,3,"
4050 RETURN
5000 SAVE "PADCALC"
5001 GOTO 1
```

Othello

A P Walrond,
Pitney,
Somerset.

BBC

THIS PROGRAM is Othello, also known as Reversi, and it runs on a Model B BBC Micro or a Model A upgraded to 32K.

The program plays a good strong game of Othello and bas two extra features:

- You can swop colours at any point in the game.
- It contains a can't go check — if you think you cannot go, the computer will check. Operating instructions are given in the program.

The average time taken by the computer to make its move is 10 seconds.

A word of advice to beginners: aim for the sides, and the corners in particular.

```
  10 REM ***OTHELLO***
  20 REM By A.P.Walrond
  30 ON ERROR GOTO 370
  40 MODE7:PROCINSTRUC
  50 MODE5
  60 VDU19,0,1,0,0,0:VDU19,1,3,0,0,0:VDU19,2,0,0,0,0
  70 COLOUR130:CLS
  80 GCOL0,0
  90 *FX11,0
 100 MOVE800,1000:MOVE800,200
 110 PLOT85,0,1000:PLOT85,0,200
 120 GCOL0,3
 130 VDU5
 140 FOR I=0 TO 800 STEP 100:MOVE I,200:PLOT21,I,1000:IF I<800 MOVEI+15,190:PRI
NT CHR$(65+(I*(1/100))
 150 NEXT I
 160 FOR I=200 TO 1000 STEP 100:MOVE 0,I:PLOT21,800,I:IF I<1000 MOVE 810,I+70:P
RINT STR$(I/100-1)
 170 NEXT I
 180 VDU4
 190 DRAW0,1000:DRAW0,200:DRAW 800,200:DRAW 800,1000
 200 DIM B%(7,7),P%(7,7),S1%(4)
 210 FOR R=0 TO 7:FOR C=0 TO 7:READ P%(R,C):NEXT C:NEXT R
 220 DATA 32,2,16,16,16,16,2,32,2,0,1,1,1,1,0,2,16,1,8,4,4,8,1,16,16,1,4,2,2,4,
1,16,16,1,4,2,2,4,1,16,16,1,8,4,4,8,1,16,2,0,1,1,1,1,0,2,32,2,16,16,16,16,2,32
 230 S%(3,3)=2:S%(3,4)=3:S%(4,3)=3:S%(4,4)=2
 240 CCM=0:YCM=0:YT%=2:CT%=2:YC=3:CC=2
 250 PROCUPDATE
 260 COLOUR1
```

(continued on page 177)

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(continued from page 175)

```
  270 PRINTTAB(0,27);"Shall I go first? ";:A$=GET$:PRINT A$
  280 REPEAT:IF A$="N" THEN A$="":PROCYMOVE:GOSUB320
  290 PROCCMOVE:GOSUB320
  300 PROCYMOVE:GOSUB320
  310 UNTIL FALSE
  320 IF YTX+CTX<64 AND (YCM+CCM1<>2 AND YTX<>0 AND CTX<>0 THEN RETURN
  330 MODE7
  340 IF YTX>CTX THEN A$=" YOU WIN" ":COL=130:ELSE IF CTX>YTX THEN A$="  I WIN""
:COL=133:ELSE A$="IT S A DRAW!":COL=132
  350 PROCWIN
  360 A=INKEY(100):PRINTTAB(10,18)"Another game?";A$=GET$:IF A$="Y" THEN RUN
  370 *FX12,0
  380 END
  390 DEFPROCUPDATE
  400 PX=0
  410 FOR YX=1000 TO 300 STEP-100
  420 FOR XX=0 TO 700 STEP 100
  430 IF POINT(XX+50,YX-50)=BX(YX/100-3,XX/100) THEN 460
  440 GCOL0,BX(YX/100-3,XX/100)
  450 MOVEXX+50,YX-5:MOVEXX+10,YX-50:PLOT85,XX+50,YX-95:MOVEXX+90,YX-50:PLOT85,X
X+50,YX-5
  460 PX=PX+1
  470 NEXT XX:NEXT YX
  480 ENDPROC
  490 DEFPROCYMOVE
  500 YCM=0
  510 *FX15,1
  520 COLOUR1:PRINTTAB(0,27);"Row number?";SPC(29);RX=GET-49:COLOUR0:IF RX>=-1 A
ND RX<=8 THEN PRINTTAB(12,27);CHR$(RX+49) ELSE VDU7:GOTO520
  530 IF RX=-1 THEN 610
  540 IF RX=8 THEN PROCSWAP:ENDPROC
  550 COLOUR1:PRINTTAB(0,28)"Column letter?";SPC(25);CX=ASC(GET$)-65:COLOUR0:IF
 (CX>=0 AND CX<=7) OR CX=-17 OR CX=-8 THEN PRINTTAB(14,28);CHR$(CX+65) ELSE VDU7
:GOTO550
  560 IF CX=-17 THEN 610
  570 IF CX=-8 THEN PROCSWAP:ENDPROC
  580 PROCCHANGE(YC,CC,1,RX,CX)
  590 IF ER=1 THEN PRINTTAB(0,27);SPC(40):VDU7:GOTO 520
  600 ENDPROC
  610 COLOUR0:PRINTTAB(0,27)"O.K. I'll check.";SPC(25)
  620 FOR R=0 TO 7:FOR C=0 TO 7:PROCCHANGE(YC,CC,0,R,C):IF ER=0 THEN C=8:R=8:GOT
O640 ELSE NEXT C:NEXT R
  630 PRINTTAB(0,28)"O.k. My go!":VDU7:A=GET(160):YCM=1:ENDPROC
  640 NEXT C:NEXT R
  650 PRINTTAB(0,28)"Yes you can'...":VDU7:A=INKEY(1600):GOTO 520
  660 DEFPROCCHANGE(YCOL,OPCOL,FILL,BX,CX)
  670 YR=RX:YCX=CX:TX=0:ER=0
  680 IF BX(BX,CX)<>0 THEN ER=1:ENDPROC
  690 DATA 1,0,1,1,0,1,-1,1,-1,0,-1,-1,0,-1,1,-1
  700 RESTORE 690
  710 FOR CHECK=1 TO 8:RX=YR:CX=YCX:READ RCX,CCX:GOSUB 760:NEXT CHECK
  720 IF TX=0 THEN ER=1:ENDPROC
  730 IF YCOL=CC AND FILL=1 THEN CTX=CTX+TX+1:YTX=YTX-TX
  740 IF YCOL=YC AND FILL=1 THEN YTX=YTX+TX+1:CTX=CTX-TX
  750 ENDPROC
  760 IF RX+RCX<0 OR RX+RCX>7 OR CX+CCX<0 OR CX+CCX>7 THEN RETURN
  770 IF BX(RX+RCX,CX+CCX)<>OPCOL THEN RETURN
  780 NX=0
  790 REPEAT
  800 BX=RX+RCX:CX=CX+CCX:NX=NX+1
  810 UNTIL RX(BX,CX)=YCOL OR RX(BX,CX)=0 OR CX+CCX<0 OR CX+CCX>7 OR BX+RCX<0 OR
 RX+RCX>7
  820 IF BX(RX,CX)<>YCOL THEN RX=0 ELSE TX=TX+RX-1
  830 IF FILL<>1 OR NX=0 THEN RETURN
  840 REPEAT
  850 BX=RX-RCX:CX=CX-CCX:NX=NX-1:BX(RX,CX)=YCOL
  860 UNTIL NX=0
  870 PROCUPDATE
  880 RETURN
  890 DEFPROCCMOVE
  900 CCM=0
  910 COLOUR0:PRINTTAB(0,27);"Thinking...            please wait.          "
  920 BIGX(0)=0:BIGX(1)=0
  930 FOR ROWX=0 TO 7:FOR COLX=0 TO 7
  940 PROCCHANGE(CC,YC,0,ROWX,COLX)
  950 IF TX=0 THEN 1000
  960 PTX=PTX(ROWX,COLX)
  970 IF PTX>2 THEN 990
  980 ON (PTX+1) GOSUB 1040,1080,1150
  990 IF TX+PTX>BIGX(0)+BIGX(1) THEN BIGX(0)=TX:BIGX(1)=PTX:BIDX(2)=ROWX:BIDX(3)
=COLX
 1000 NEXT COLX:NEXT ROWX
 1010 IF BIGX(0)=0 THEN VDU7:PRINTTAB(0,27);"I can't move";SPC(27):A=INKEY(1601
):ENDPROC
 1020 FOR I=1 TO 3:BX(BIDX(12),BIDX(3))=CC:PROCUPDATE:BX(BIDX(2),BIDX(3))=0:PROCU
PDATE:NEXT I:PROCCHANGE(CC,YC,1,BIDX(2),BIDX(3))
 1030 ENDPROC
 1040 IF ROWX<3 THEN R=0 ELSE R=7
 1050 IF COLX<3 THEN C=0 ELSE C=7
 1060 IF BX(R,C)<>0 THEN PTX=8
 1070 RETURN
 1080 PTX=6
 1090 IF ROWX>1 AND ROWX<6 THEN RM=0 ELSE IF ROWX<3 THEN RM=-1 ELSE RM=1
 1100 IF COLX>1 AND COLX<6 THEN CM=0 ELSE IF COLX<3 THEN CM=-1 ELSE CM=1
 1110 IF BX(ROWX+RM,COLX+CM)<>CC THEN PTX=PTX-2
 1120 IF BX(ROWX+RM+CM,COLX+CM+RM)<>CC THEN PTX=PTX-2
 1130 IF BX(ROWX+RM-CM,COLX+CM-RM)<>CC THEN PTX=PTX-2
 1140 RETURN
 1150 IF ROWX=1 THEN RM=-1 ELSE IF ROWX=6 THEN RM=1 ELSE RM=0
 1160 IF COLX=1 THEN CM=-1 ELSE IF COLX=6 THEN CM=1 ELSE CM=0
 1170 IF BX(ROWX+RM,COLX+CM)=0 THEN PTX=0
 1180 IF BX(ROWX+RM,COLX+CM)=CC THEN PTX=16
 1190 RETURN
 1200 DEFPROCWIN
 1210 PRINTTAB(8,10);CHR$(136);CHR$(COL);CHR$(141);A$
 1220 PRINTTAB(8);CHR$(136);CHR$(COL);CHR$(141);A$
 1230 ENDPROC
 1240 DEFPROCINSTRUC
 1250 PRINTTAB(12);CHR$(130);CHR$(141);"OTHELLO";TAB(12);CHR$(130);CHR$(141);"OT
HELLO";TAB(11);CHR$(130);CHR$(141);"********"
 1260 PRINT:PRINT CHR$(132);"Instructions:"
 1270 PRINT:PRINT"You must try to beat the computer at    this game called  OTHE
LLO . The program  incorporates several special features   to make the game easie
r and more         interesting."
 1280 PRINT:PRINT"You start off as WHITE,but you may      change colour during y
our turn simply   by typing  9 ."
 1290 PRINT:PRINT"If you think you can't go,type  0  and  the computer will chec
k.If it finds thatyou can go,it will tell you;otherwise   it takes its move."
 1300 PRINT CHR$(131);"Press any key to continue"
 1310 A=GET:ENDPROC
 1320 DEFPROCSWAP
 1330 COLOUR0:PRINTTAB(0,27);"O.K.-Colours swaped.  -You are now ";
 1340 IF YC=3 THEN PRINT"BLACK" ELSE PRINT"WHITE"
 1350 SW=YC:YC=CC:CC=SW:SW=YTX:YTX=CTX:CTX=SW
 1360 VDU7:A=INKEY(200):ENDPROC
```

Filecard

Steve Jeynes,
Barry,
South Glamorgan.

SPECTRUM

FILECARD IS a database-type program for storing information on the 48K Spectrum. The program is written in Basic which has obvious limitations but is still able to offer all the usual features associated with database programs, plus a couple of extra features I have put in myself.

I have tried to make the display on the screen as interesting and attractive as possible. I have come across some database programs before but found them very boring, especially in the display format, and as a result they never captured my interest. It was because of this that I wrote the Filecard program.

Most of the database programs I had come across held the data as a single or double line of information, held in one string

DIM A$ (100,32)

which allows for 100 files each with a length of 32 characters per file. This would be displayed as a single line of information across the screen from left to right. With the Filecard program the data is displayed as eight lines each with 15 characters — a total of 120 characters per file — and is placed as a block of information in the centre of the screen.

I have tried to create a card-type display rather than a couple of lines of data across the screen. I had to sacrifice the number of files that would be available to the user in order to make the most of the Spectrum's colour, and add the extra features which are available in the Filecard program. There are, in fact, only 250 files available but this number could be increased slightly by not using the colours of the Spectrum. I think that if you have the colour facility you should make the most of it. Database-type programs will come into their own once the long-awaited Microdrive is made available, as it will mean very fast retrieval of data which has been stored outside the computer.

I used a single string array A$, but I made it a three-dimensional array. This way allows for a number of different entries per file ie.,

DIM A$ (250,8,15)

which gives us 250 files each with eight lines containing 15 characters each. With this type of array the format for the display could be made to resemble that of a small filecard, see figure 1.

```
FILECARD NO.  1

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```

Figure 1.

The features of this program are:

Terminate. This option allows you to stop the program. If you exit the program and then decide to continue, providing the program is still in the computer, you can type Goto 330, which is the start of the menu routine, and the files which were in the computer will still be there.

Add a filecard. This allows the input of filecards through the keyboard. Each line is entered as a string of 15 characters, a For-Next loop does this eight times — the number of lines per file. There is also a facility to correct any mistakes that are made during the entry of files. After all the files have been entered they are sorted into alphabetical order.

Search a filecard. You simply enter the name of the file you wish to see and the computer will search through all the file names until it finds the one you chose. It will then print the whole file on the screen.

Save filecards. This option allows the user to Save files on to cassette. Data is Saved twice.

Load filecards. This allows the user to load files from cassette.

List filenames. This option takes the first line of every file and prints in a list. Each file is in alphabetical order and is numbered. There is the optional output to printer in this routine.

List filecards. This option displays each file, in a complete form, on the screen. The files are in alphabetical order and each is numbered. There is also the optional output to the printer if required.

Scan filecards. This allows the user to browse through the filecards at his own pace. When entering this routine the first filecard to be displayed is number 1, by pressing any key except P or Q you can move on to the next file. The P key allows you to move backwards down the list. The Q key will return the user to the menu. All the filecards are displayed in their complete form.

Alter filecards. This allows the user to alter a filecard at any time. The filecard is displayed on the screen; all the user has to do is position

(continued on page 179)

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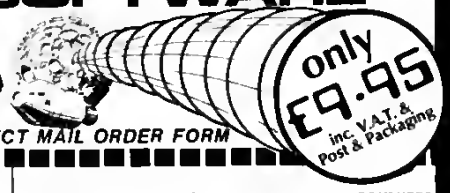
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(continued from page 177)

the small cursor alongside the line they wish to change. Changing that line is a simple task.

All these options are easy to use and all the instructions needed are printed on the screen for you.

The lack of files is one of the bad points about the program. Another bad point is the time it takes to sort. This is because every time a swap has to take place, all the information which is held in eight lines has to be swapped as well, making it a very long process. The routine uses a For/Next loop to transfer the file in the sort but it does take its time.

Program notes.
POKE 23658,8 forces caps lock on
POKE 23609,50 is the keyboard bleep
POKE 23692,0 will scroll the screen
There are no Rem statements in order to allow maximum storage area. A$ is the dimensioned array for holding the filecards

```
  10 PAPER 0: INK 7: BORDER 0: CLS
  20 PAPER 0: INK 7: BORDER 0:
  30 PRINT INK 6; BRIGHT 1;AT 10, 11;" F
ILECARD 1 ";AT 19,0;"By Steve Jeynes";AT
 21,0;"PRESS ANY KEY TO CONTINUE"
  40 POKE 23609,50: POKE 23658,8
  50 LET F$="FILECARD NO. ": LET N$="NAM
E-    ": LET H$="DETAILS-": LET L$="MAX.
15 CHR$ PER LINE": LET E$="NAX. 8 LINES
PER CARD": LET G$="ENTRY NO. "
  60 DIM a$(250,8,15): LET E=1
  70 PAUSE 0: CLS
  80 GO TO 330
  90 REM INPUT FILES
 100 PRINT INK 7; BRIGHT 1;AT 0,9;"FILEC
ARD ENTRY"
 110 GO SUB 820: GO SUB 910
 120 PRINT INK 5; BRIGHT 1;AT 3,23;E
 130 PRINT AT 19,0;"
                ";AT 20,0;"
                    ";AT 21,0;"
                    "
 140 PRINT INK 7; BRIGHT 1;AT 20,3;G$
 150 FOR J=1 TO 8
 160 PRINT INK 7; BRIGHT 1;AT 20,12;J
 170 PRINT BRIGHT 1; INK 7;AT J+4,13;">>
"
 180 INPUT A$(E,J,1 TO 15)
 190 IF A$(E,J)="Q1                  " THEN L
ET A$(E,J)="                    ": GO TO 240
 200 PRINT INK 6; BRIGHT 1;AT J+4,13;A$(
E,J)(1 TO LEN A$(E,J)): NEXT J
 210 BEEP .5,50: LET F=E: GO SUB 930
 220 BEEP .10,10: LET E=E+1: IF E>200 TH
EN GO TO 240
 230 PAUSE 50: FOR J=1 TO 8: PRINT AT J+
4,13;"                    ": NEXT J: GO TO 12
0
 240 REM SORT
 250 CLS : PRINT INK 4; BRIGHT 1; INVERS
E 1;AT 0,6;"STAND BY- SORTING"
 260 FOR B=1 TO E-1: FOR C=B+1 TO E-1
 270 IF A$(B,1)<=A$(C,1) THEN GO TO 300
 280 FOR J=1 TO 8
 290 LET D$=A$(B,J): LET A$(B,J)=A$(C,J)
: LET A$(C,J)=D$: NEXT J
 300 NEXT C
 310 NEXT B
 320 PRINT INK 5; BRIGHT 1; INVERSE 1;AT
 0,6;" SORTING COMPLETE ": FOR H=-20 TO
20: BEEP .010,H: NEXT H: CLS
 330 REM MENU
 340 PRINT INK 6; BRIGHT 1;AT 0,11;"OPTI
ONS";AT 2,7;"1 - TERMINATE";AT 4,7;"2 -
ADD A FILECARD";AT 6,7;"3 - SEARCH A FIL
ECARD";AT 8,7;"4 - SAVE FILECARDS";AT 10
,7;"5 - LOAD FILECARDS";AT 12,7;"6 - LIS
T FILE NAMES";AT 14,7;"7 - LIST FILECARD
S";AT 16,7;"8 - SCAN FILECARDS";AT 18,7;
"9 - ALTER FILECARDS"
 350 IF INKEY$="" THEN GO TO 350
 360 IF INKEY$="1" THEN CLS : PRINT INK
6; BRIGHT 1;AT 10,0;"DO YOU WISH TO STOP
 THE PROGRAM?": INPUT BRIGHT 1;"ENTER Y
/ N";B$: IF B$="Y" THEN STOP
 370 IF INKEY$="2" THEN CLS : GO TO 090
 380 IF INKEY$="3" THEN CLS : GO TO 460
 390 IF INKEY$="4" THEN CLS : GO TO 530
 400 IF INKEY$="5" THEN CLS : GO TO 570
 410 IF INKEY$="6" THEN CLS : GO TO 600
 420 IF INKEY$="7" THEN CLS : GO TO 1180
 430 IF INKEY$="8" THEN CLS : GO SUB 108
0
 440 IF INKEY$="9" THEN CLS : GO TO 740
 450 CLS : GO TO 330
 460 REM SEARCH
 470 INPUT BRIGHT 1;"HARD COPY?  (Y/N)";
B$
 480 CLS : PRINT BRIGHT 1; INK 1; PAPER
7;AT 10,2;"ENTER FILE TO BE SEARCHED FOR
": LET F=E
 490 INPUT Z$
 500 IF Z$=A$(F,1)( TO LEN Z$) THEN CLS
: PRINT BRIGHT 1; INK 1; PAPER 6;AT 1,10
;"FILE FOUND": GO SUB 820: PRINT INK 5;
BRIGHT 1;AT 3,23;F: FOR J=1 TO 8: PRINT
INK 7;AT J+4,13;A$(F,J): NEXT J: PAUSE 4
00: IF B$="Y" THEN COPY : CLS : GO TO 33
0
 510 IF F>I THEN LET F=F-1: GO TO 500
 520 CLS : PRINT INK 2; PAPER 7; INVERSE
1;AT 21,7;"FILE SEARCH COMPLETE": GO TO
330
 530 REM SAVE DATA
 540 FOR V=1 TO 2: CLS
 550 PRINT INK 7; BRIGHT I;AT 4,9;"SAVIN
G DATA A$": SAVE "DATA" DATA A$(): NEXT V
 560 CLS : PRINT INK 7; BRIGHT 1;AT 4,9;
"SAVE COMPLETE": PAUSE 100: CLS : GO TO
330
 570 REM LOAD DATA A$
 580 CLS : PRINT INK 7; BRIGHT I;AT 0,7;
"LOADING DATA A$": LOAD "DATA" DATA A$()
 590 CLS : GO TO 330
 600 REN LIST
 610 PRINT INK 7; BRIGHT 1;AT 7,0;"PRESS
 ""P"" KEY TO HOLD LIST       PRESS ANY K
EY TO CONTINUE LIST  NO HOLD WHEN PRINTE
R IS USED"
 620 LET E=1: INPUT BRIGHT 1;"HARD COPY?
 (Y/N)";B$: CLS
 630 IF A$(E,1)="                    " THEN G
O TO 710
 640 IF INKEY$="P" THEN PAUSE 0
 650 PRINT INK 7; BRIGHT 1;A$(E,1); INK
5; INVERSE 1;" ""NO.-";E;CHR$ 94: PRINT
 660 IF INKEY$="P" THEN PAUSE 0
 670 IF B$="Y" THEN LPRINT A$(E,1); INVE
RSE 1;" ""NO.-";E;CHR$ 94: LPRINT
 680 IF INKEY$="P" THEN PAUSE 0
 690 LET E=E+1: PAUSE 30: POKE 23692,0:
GO TO 630
 700 PAUSE 200: CLS : GO TO 330
 710 PRINT FLASH 1; INK 6; PAPER 1;"LIST
 COMPLETE"
 720 IF B$="Y" THEN LPRINT "LIST CONPLET
E"
 730 PAUSE 100: CLS : GO TO 330
 740 REM ALTER FILE
 750 CLS : INPUT BRIGHT 1;"ENTER FILE NU
MBER TO BE CHANGED ";F: GO SUB 820: GO S
UB 910
 760 PRINT INK 7; BRIGHT 1;AT 3,23;F: FO
R J=1 TO 8: PRINT INK 6; BRIGHT 1;AT J+4
,13;A$(F,J): NEXT J
 770 GO SUB 970
 780 INPUT BRIGHT 1;"ALTER ANOTHER FILE?
  (Y/N)";B$
 790 IF B$="Y" THEN GO TO 750
 800 CLS : GO TO 240
 810 RUN
 820 REM DRAW
 830 INK 5: PAPER 0: BRIGHT 1
 840 PLOT 28,68: DRAN 200,0: DRAW 0,88
 850 PLOT 28,156: DRAN 0,-88
 860 PLOT 228,156: DRAN -200,0
 870 PLOT 28,140: DRAN 200,0
 880 PLOT 100,140: DRAN 0,-72
 890 PRINT AT 3,9;F$;AT 5,4;N$;AT 6,4;H$
 900 RETURN
 910 PRINT INK 7; BRIGHT 1;AT 15,3;L$;AT
 14,3;E$
 920 RETURN
 930 INPUT BRIGHT 1;"IS THIS FILE CORREC
T?  (Y/N)    ";B$
 940 IF B$="Y" THEN RETURN
 950 IF B$="N" THEN GO TO 970
 960 GO TO 930
 970 PRINT INK 7; BRIGHT 1;AT 19,0;"PRES
S ""A"" TO SELECT INCORRECT   ENTRY WITH
 << CURSOR""PRESS ""P"" WHEN SELECTED"
;AT 5,30;"<<"
 980 LET J=1
 990 LET S$=INKEY$: IF S$="" THEN GO TO
990
1000 IF S$="P" THEN GO TO 1050
1010 IF S$="A" THEN LET J=J+1
1020 IF J=9 THEN PRINT AT J+3,30;"  ": L
ET J=1
1030 PRINT INK 7; BRIGHT 1;AT J+4,30;"<<
";AT J+3,30;"  "
1040 PAUSE 100: GO TO 990
1050 INPUT BRIGHT 1;"INPUT CORRECT ENTRY
                ";A$(F,J)
1060 PRINT INK 6; BRIGHT 1;AT J+4,13;A$(
F,J);AT J+4,30;"  "
1070 GO TO 930
1080 LET F=1
1090 GO SUB 820: PRINT INK 7; BRIGHT 1;A
T 18,0;"PRESS ""P"" TO SCAN PREVIOUS FIL
E PRESS ""Q"" TO RETURN TO NENU      PRES
S ANY OTHER KEY TO CONTINUE"
1100 IF F<I THEN LET F=1
1110 PRINT INK 7; BRIGHT 1;AT 3,23;F;" "
: FOR J=1 TO 8: PRINT AT J+4,13;A$(F,J):
 NEXT J
1120 IF INKEY$="" THEN GO TO 1120
1130 IF INKEY$="P" THEN LET F=F-I: GO TO
 1100
1140 IF INKEY$="Q" THEN CLS : GO TO 330
1150 IF INKEY$<>"P" ANO INKEY$<>"Q" THEN
 LET F=F+1
1160 IF F=E THEN CLS : PRINT INK 7; BRIG
HT 1;AT 1,10;"NO NORE FILES": PAUSE 100:
 CLS : GO TO 330
1170 GO TO 1100
1180 INPUT BRIGHT 1;"HARD COPY?  (Y/N)";
B$
1190 LET F=1: GO SUB 820
1200 FOR J=1 TO 8
1210 PRINT INK 7; BRIGHT 1;AT 3,23;F;AT
J+4,13;A$(F,J)
1220 NEXT J
1230 PAUSE 100
1240 IF B$="Y" THEN COPY
1250 IF F=E-1 THEN GO TO 1280
1260 LET F=F+1
1270 GO TO 1200
1280 CLS : PRINT INK 7; BRIGHT 1;AT 3,10
;"LIST COMPLETE": PAUSE 100: CLS : GO TO
 330
```

Renumber

G M Jackson,
Osmkirk,
Lancashire.



THIS IS A useful renumber program for the Oric 1. Oric owners should find the way it utilises some of the machine's addressing features informative. Although it is written in Basic it is surprisingly fast.

The program only renumbers program lines and does not alter the number after Gosubs and Gotos. To use it simply tag it on the end of the program you want to renumber and enter Goto 63900.

```
 10 REM THE PROGRAM USES THE FOLLOWING VARIABLES:
 20 REM DEEK(£9A) = THE START OF BASIC PROGRAM
 30 REM DEEK(£9C) = END OF BASIC PROGRAM = E
 40 REM A = ADDRESS OF BASIC PROGRAM LINE = DEEK(A)
 50 REM N = LINE NUMBER
 60 REM S (INITIALLY) = START LINE NUMBER FROM
 70 REM I = INCREMENT
 63900 REM FOR £ READ HASH CHARACTER
 63905 PRINT CHR$(12);SPC(10)"RENUMBER":PRINT
 63910 INPUT "COMMENCE LINE NUMBERS FROM";S
 63915 IF S<1 OR S>63B99 THEN GOTO 63910
 63920 INPUT "INCREMENT BY";I
 63925 IF I<1 OR I>100 THEN GOTO 63920
 63930 A=DEEK(£9A):E=DEEK(£9C)
 63935 N=DEEK(A+2)
 63940 IF N>=63900 OR A>E THEN PRINT"RENUMBER COMPLETED":END
 63945 DOKEA+2,S:S=S+I:A=DEEK(A)
 63950 GOTO 63935
```



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COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in September. The name of the winner, the solution, and a competition report will be published in the November, 1983 issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

COMPETITION RESULTS AND WINNERS

"I WOULD LIKE AN Electron to enter my orbit because . . ." was the way July's competition sentence began. Most competitors drew their inspiration from physics. The electron, it appears carries a negative charge and attracts particles with a positive charge. Almost a hundred people were struck by this fact and started their entries with "I am positive . . .". B. Moxley said simply, "I am positive I would be attracted to it", while N Langley confessed "I am positively unstable without it". The winning entry came from R Warriner, 59 Reeds Lane, Moreton, Wirral, who wrote "I am positively excited by it current potential".

Other variations on the nuclear theme were R Munday's "I don't want to Bobr people with my Atom".

Competitors had clearly ransacked their physics textbooks for appropriate puns, as in R Booth's "coming with no charge would give it a unique charm" and E Jupp's "it would bring me out of my shell by a quantum leap". The most ingenious of these perhaps was "I.C. I can't resistor current micro: watt ohms not ampered without one" from N Reckert.

Leptons, protons, positrons, neutrons, quarks all made an appearance but particle of the month was undoubtedly the ion. "Ion-estly find myself attracted by its high positive potential" quipped M Cutler. And in common with several others S Baker reported "I have had my ion it for some time".

Only a few entries managed to escape from the world of particles and electricity. P Mullen suggested "its a dream-piece rainbow warrior to harpoon tbe wailing industry" and B Turner offered "If win <> Electron then repeat Goto arcade until cashflow = 0".

The Trinary Tribulation puzzle was almost too easy for most competitors. Finding a solution only requires that you convert the decimal number 282506 to its trinary equivalent, 1121000112012. If you now consult the table of alphabetic codes you can translate four groups of three "trits" to give the answer, NINE.

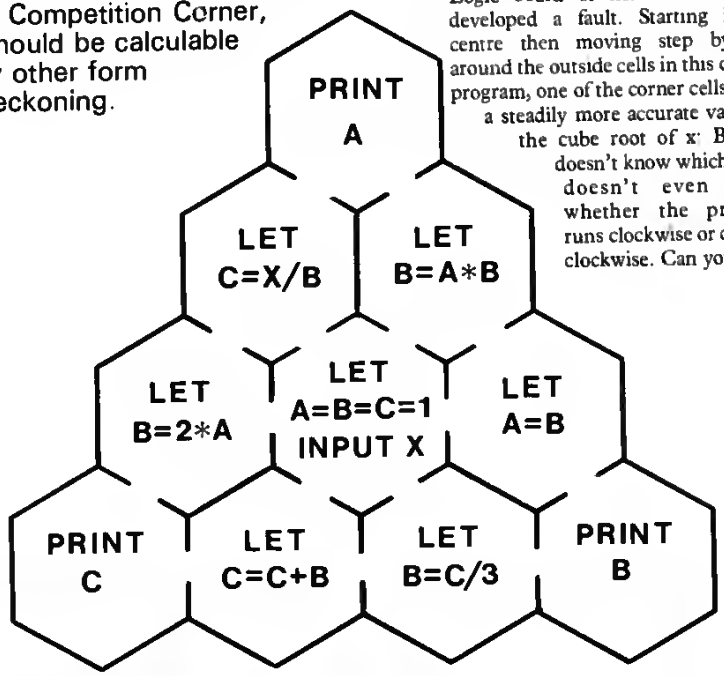
We awarded the £15 book token to A Caslaw, 31 Purton Stoke, Swindon, Wilts, who submitted the following program to run on a ZX81:

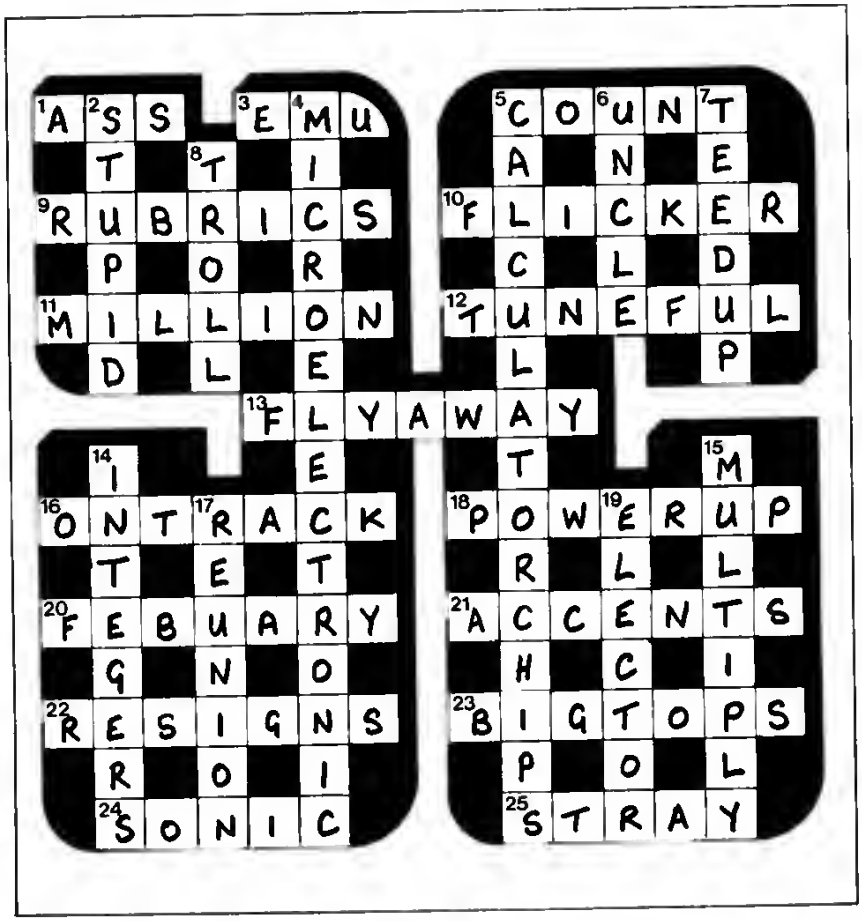
```
10 LET A$=""
20 INPUT X
30 LET Y=X/27
40 LET X=INT Y
50 LET B$=CHR$ (27*(Y-X)+37)
60 LET A$=B$+A$
70 IF X>0 THEN GOTO 30
80 PRINT A$
```

HONEYCOMB

BY ANTHONY ROBERTS

THE QUEEN OF the hive-ship Sting has another problem — the Honeycomb Logic board of her hex-micro has developed a fault. Starting in the centre then moving step by step around the outside cells in this cellular program, one of the corner cells prints a steadily more accurate value for the cube root of x: But she doesn't know which — she doesn't even know whether the program runs clockwise or counter clockwise. Can you help?





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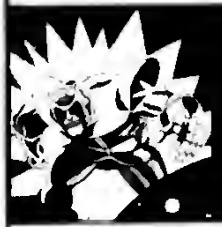
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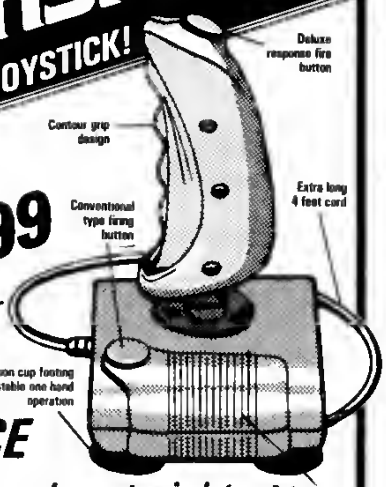
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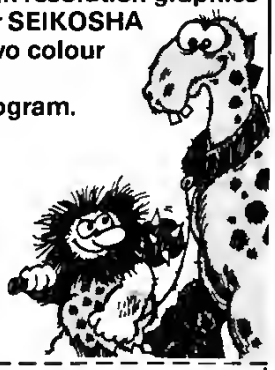
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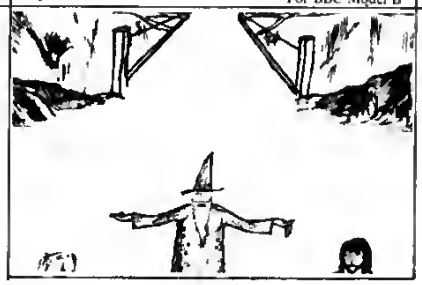
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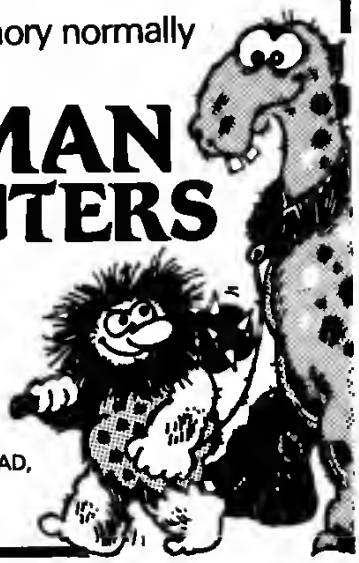
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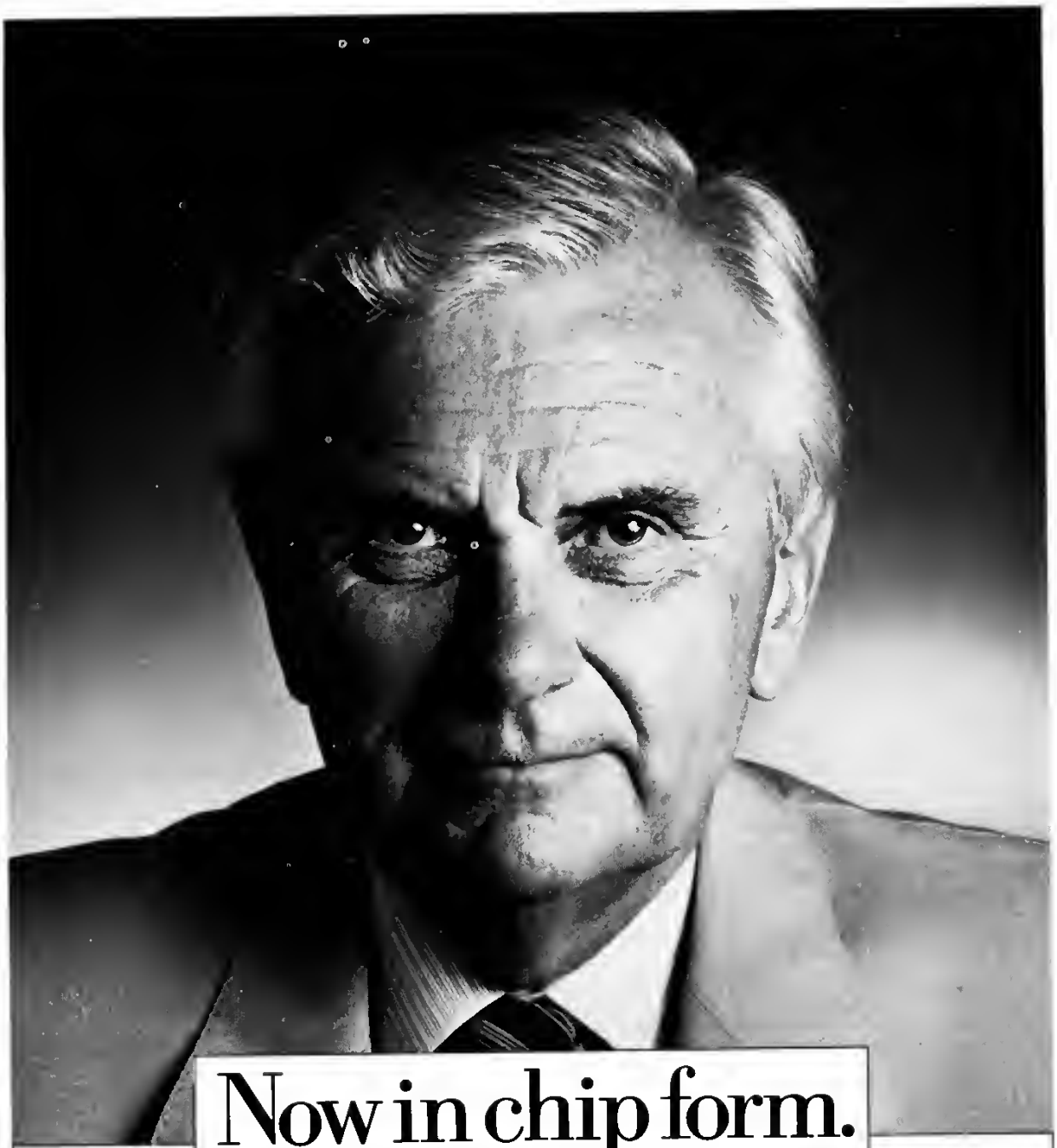
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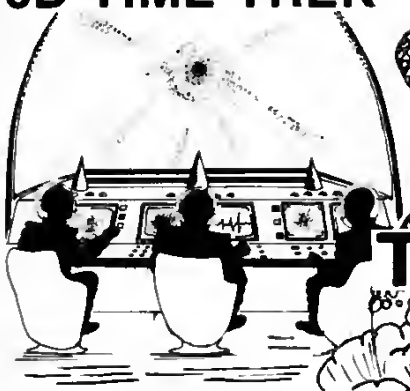
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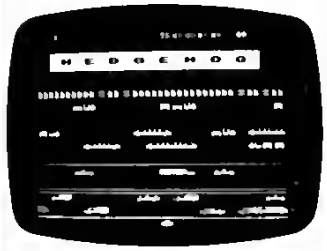
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March issue: Program Features: Life (32K), Artillery Duel (16K/32K), Square Dance, Microsketch (16K) screen drawing program in only one line of code. 3D Rotation (will rotate any object). Printers for the BBC micro — Review of Epson, Seikosha, Tandy and Olivetti. What to do with the new Operating System Chip. Disc Formatter Program and full Disc Instruction set. Newcomers article on Text and Graphics Windows. **PLUS** How to get a new Operating System ROM and a special deal on Wordwise (members only).

April/May issue Special Anniversary Issue — Contains Index to the whole of BEEBUG Volume 1. Music Composer — create complex 3 part harmonies with the synthesiser Program. **Colour bar chart generator** program. Beeb implementation of the **Connect Four Game**. **Invasion** — a 16K Plus **Review of Tape Recorders** for the Beeb. a Basic Program Editor, which lists variables and procedures and executes find and Replace in a Basic Program. **Reviews of Acornsoft Games** and the **Tom-h Z80 Disc Pack**. Disc Menu Program. Newcomers introduction to Mode 7. How to save the unsaveable and a routine to print Double Height characters in all modes.

June issue: Program Features: **Return of the Diamond**. A 16K adventure game. **'hedgehog'** a well implemented 'Frogger' type game, and **Ellipto**. Create your own off the shelf sound effects with **Sound Wizard**. Plus articles on **using Files, Rotating and Expanding Characters, Using Printers,** and **How to multi-program the User Keys.** Reviews of **The Hobbit, Floppy Tape System, Adventure Games,** and a **Comparative Review of Wordwise and View**. Plus **FX Call Update, Disc Program Auto-relocator, Wordwise Update** and more **BBC Book Reviews**.

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BEEBUG has negotiated a deal with ACORN over the new 1.2 OPERATING SYSTEM ROM. BEEBUG members are offered the ROM at around half price. See BEEBUG Feb. issue for details.

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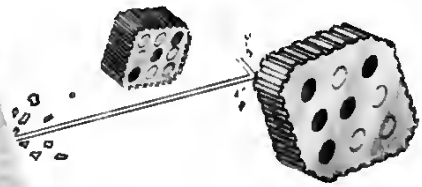
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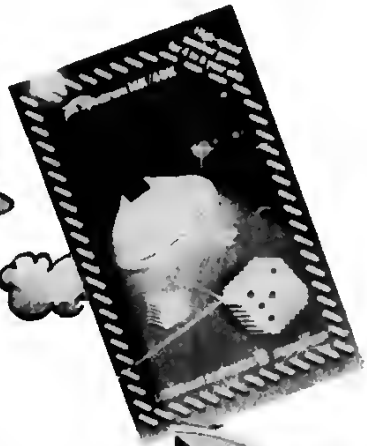




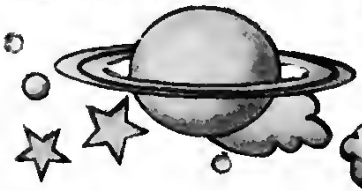
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2 DEAD IN EVEREST TRAGEDY

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XARG ESCAL
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said yesterday

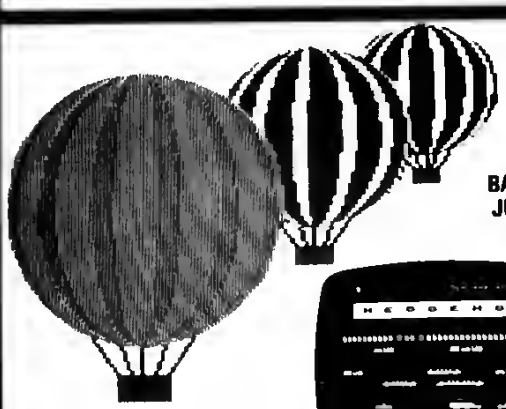
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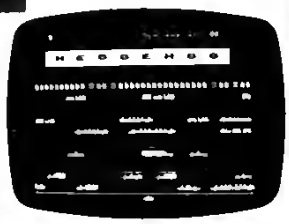
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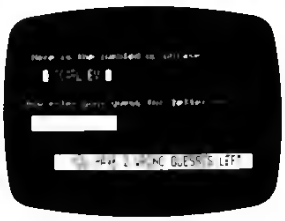
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RETURN OF THE DIAMOND
JUNE/JULY 1983



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February Issue. *Program Features.* BEEBMAZE—Find your way through the random maze, guided by 3D views from inside the maze—an excellent game. FIVE DICE—A Beeb implementation of YAHTZEE (R), a novel dice game. Also a listing of WINDY FIELD—a creation from Acornsoft, SPIRDPLOT screen doodler, and a complete memory display program in a user key. Plus Machine Code Screen Dumps for the Epson and Seikosha Printers, articles on USING FILES, IDEAS ON ANIMATION (Including a Rotating Cube program), an Introduction to the Use of Procedures, a Survey of Books on the BBC Micro, and a Roundup of Disc System Hints. PLUS a variety of HINTS, TIPS AND INFO, including a single VDU command to perform a SIDEWAYS SCROLL.

March Issue. Program Features. Life (32K), Artillery Duel (16K/32K), Square Dance. 3D Rotation (will rotate any object). Printers for the BBC micro—Review of Epson, Seikosha, Tandy and Olivetti. What to do with the new Operating System, Disc Formatter Program, and full Disc instruction set. Newcomers article on Text and Graphics Windows. PLUS How to get a new Operating System ROM and a special deal on Wordwise (members only).

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July Issue: Games. Robot Attack (32K) and Anagrams, a 1BK word game. Watching the Beeb at work — a simple program to show your micro at work. An introduction to discs —what are they and are they worth getting. Balloons — a coloured animation. Make your micro speak like Kenneth Kendal. Bad Program Lister — lists programs even when the computer pronounces them 'bad'. Reviews of Epson and Seikosha's new printers. Five books of programs reviewed, plus more software reviews. Using Files part 4. A full disc sector editor program — to read and retrieve lost disc files. And how to modify Acornsoft's Planetoid. Plus hosts of useful hints.

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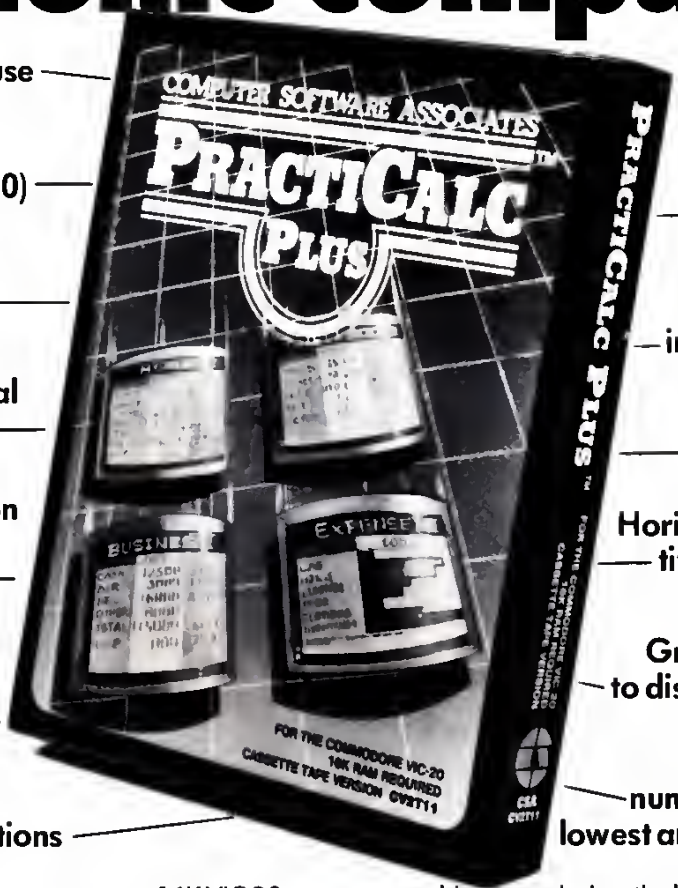
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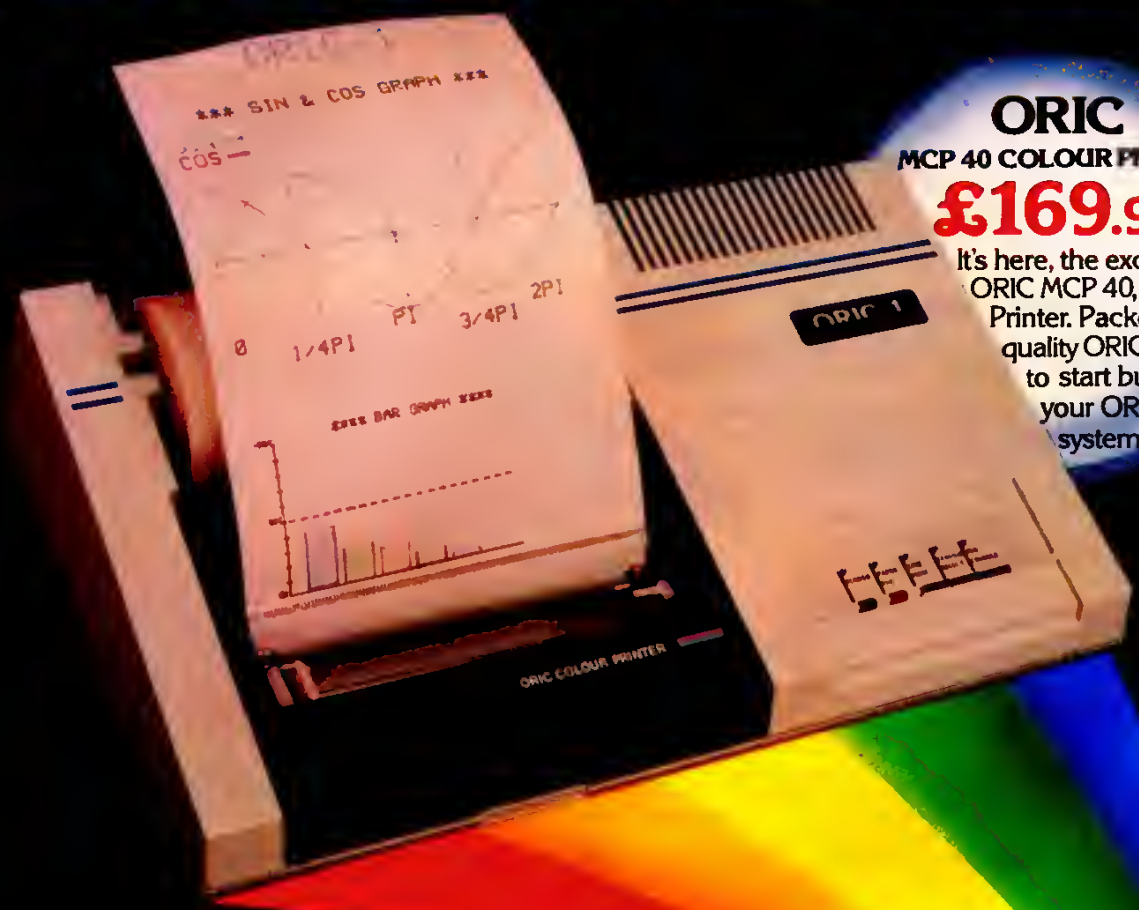
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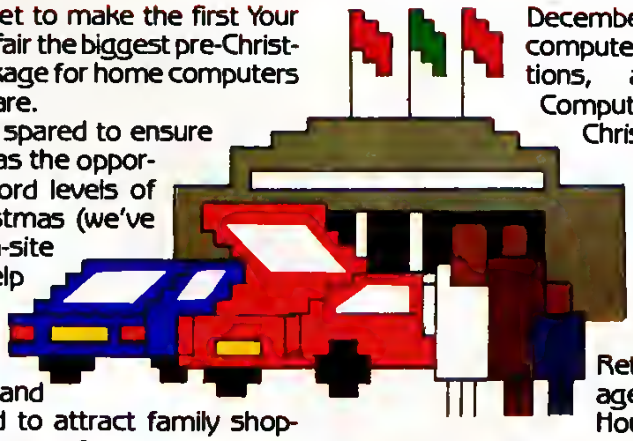
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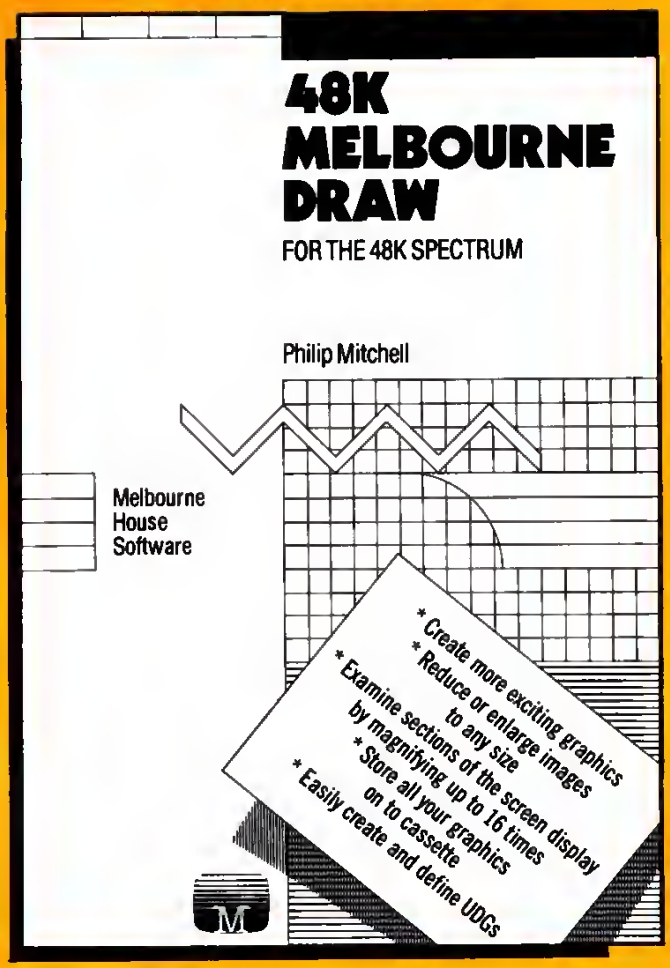
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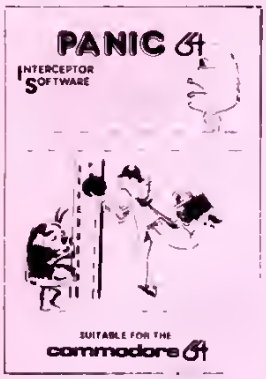
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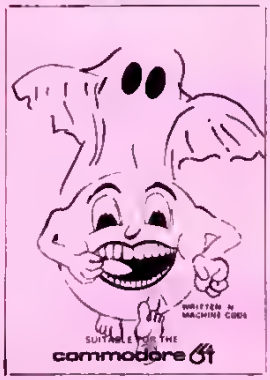




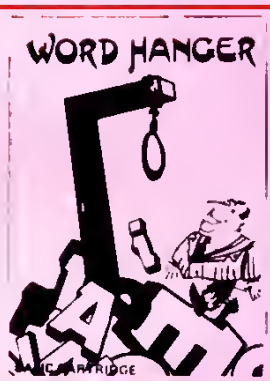












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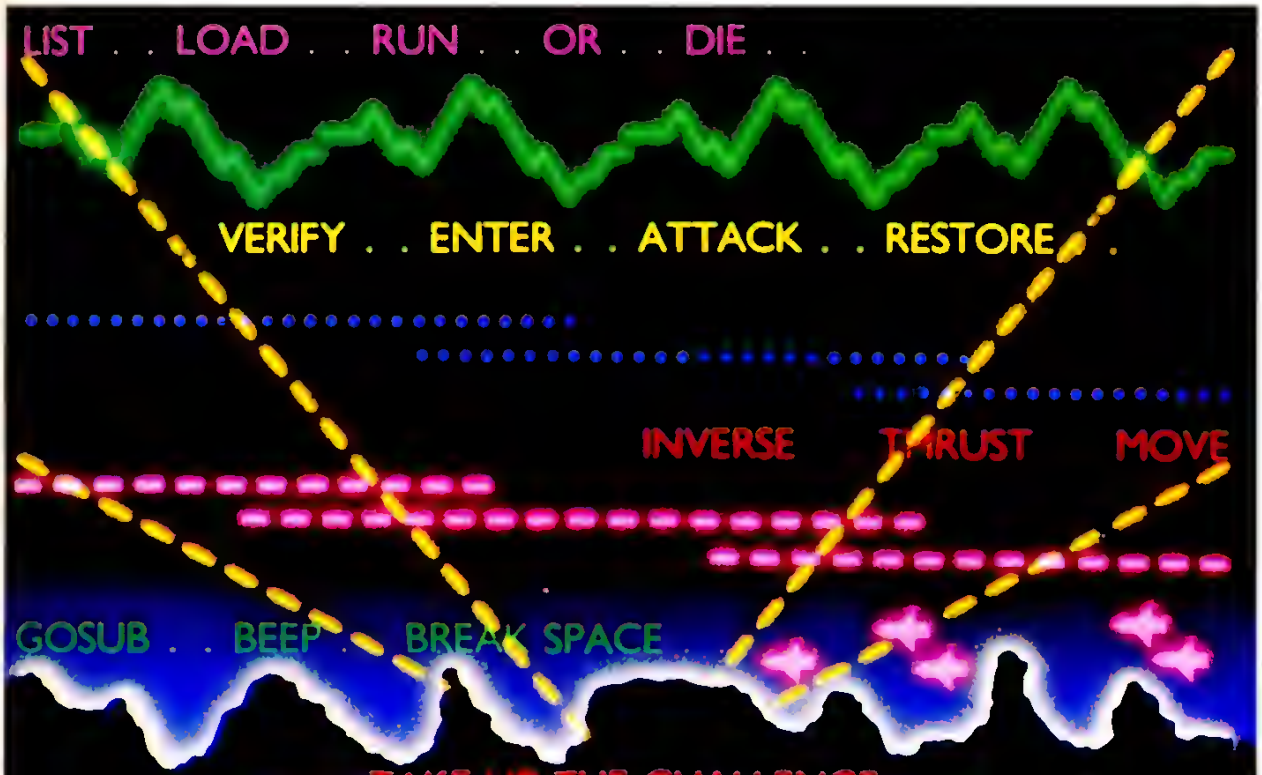
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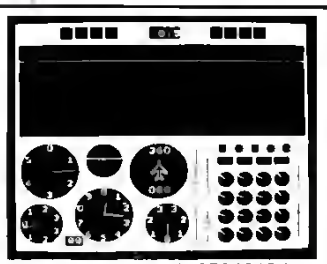
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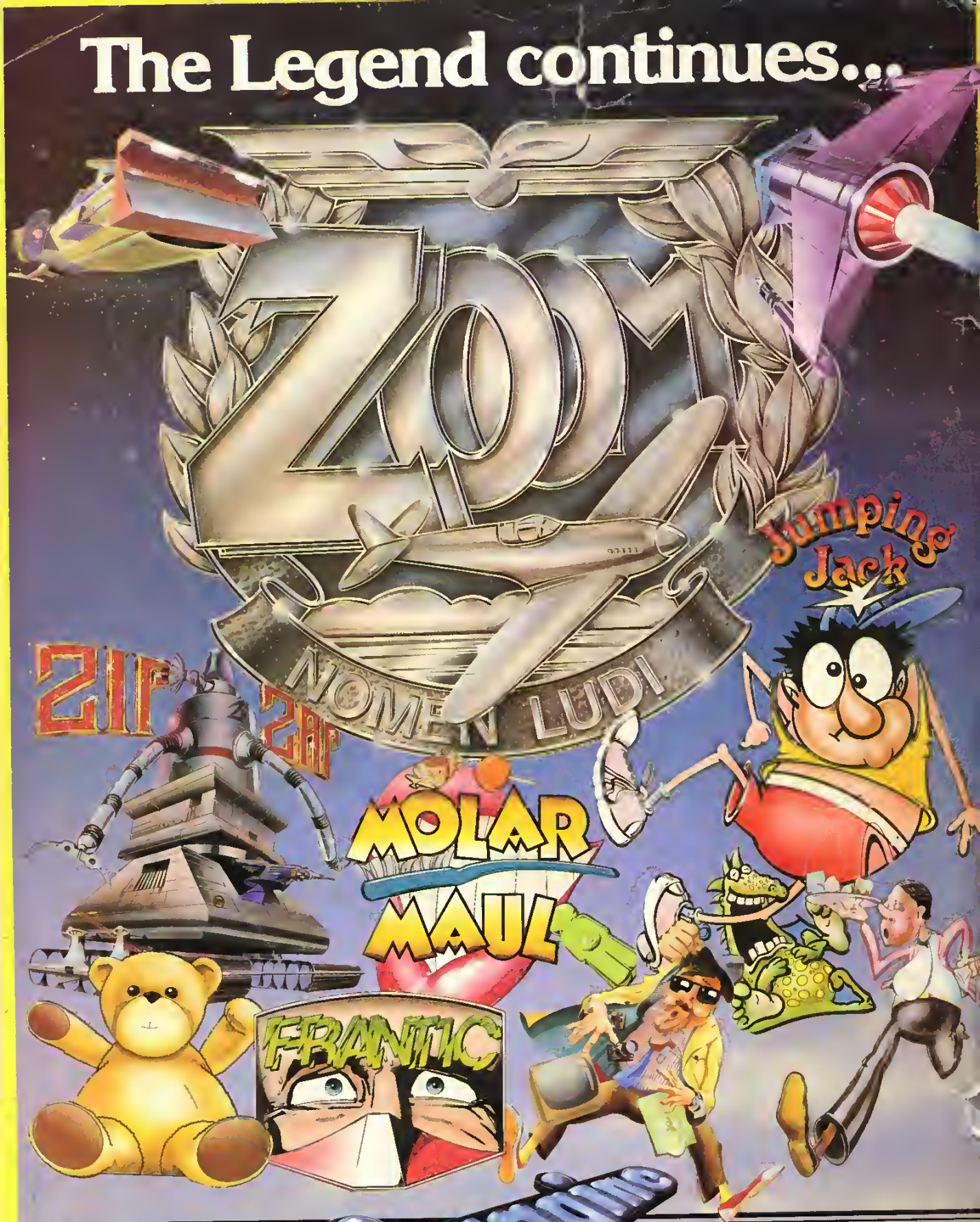
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